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-- End of Project Table of Contents --

APPENDIX

Subsurface Exploration and Geotechnical Engineering Report

INC 00102.CVR>

DOCUMENT 00102

LIST OF DRAWINGS

12/97

1.1 SUMMARY

This document lists the drawings for the project pursuant to contract clause "DFARS 252.236-7001, Contract Drawings, Maps and Specifications."

1.2 CONTRACT DRAWINGS

Contract drawings are as follows:

SHEET NO.	DRAWING NO.	NAVFAC NO.	TITLE
1	T-1	3179470	Title Sheet
2	C-1	3179471	Legend, Notes and Details
3	C-2	3179472	Site Plan
4	C-3	3179473	Site Details
5	C-4	3179474	Sewer and Water Profiles
6	A-1	3179475	Floor Plan, Material Schedule and Finish Schedule
7	A-2	3179476	Exterior Elevations
8	A-3	3179477	Building Sections and Details
9	A-4	3179478	Wall Sections and Details
10	A-5	3179479	Roof Plan and Details
11	A-6	3179480	Enlarged Toilet Plans, Elevations Details and Legend
12	A-7	3179481	Door and Window Types, Details and Schedules
13	S-1	3179482	Notes
14	S-2	3179483	Foundation Plan, Notes and Schedules
15	S-3	3179484	Hollow Core Ceiling Plan and Notes
16	S-4	3179485	Roof Framing Plan
17	S-5	3179486	Typical Details
18	P-1	3179487	General Notes and Legend
19	P-2	3179488	Plumbing Plan
20	M-1	3179489	Mechanical General Notes and Legend
21	M-2	3179490	Mechanical Floor Plan
22	M-3	3179491	Mechanical Details
23	M-4	3179492	Mechanical Schedules and Details
24	M-5	3179493	Mechanical Control Legend and Diagrams
25	E-1	3179494	Electrical Legend, Schedule and Notes
26	E-2	3179495	Floor Plan-Lighting
27	E-3	3179496	Floor Plan-Power

SHEET NO.	DRAWING NO.	NAVFAC NO.	TITLE
28	E-4	3179497	Lighting Details
29	E-5	3179498	Electrical Riser Diagrams

-- End of Document --

SECTION 01110

SUMMARY OF WORK
03/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

MILITARY SPECIFICATIONS (MIL)

MIL-I-16165	(Rev. E) Shielding Harness, Shielding Items and Shielding Enclosures for use in Reduction of Interference from Engine Electrical Systems
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MILITARY STANDARDS (MIL-STS)

MIL-STD-461E	(Rev. D) Control of Electromagnetic Interference Emissions and Susceptibility
MIL-STD-462	(Rev. D) Electromagnetic Interference Characteristics

1.2 WORK COVERED BY CONTRACT DOCUMENTS

1.2.1 Project Description

The work includes new construction for an Armory and incidental related work.. The Armory, approximately 1,800 SF with 301 SF covered area, will replace the existing Armory located within Barracks 2106. Foot print within the Armory's restricted area includes an area for weapons storage, maintenance and issuing. A shower room will be provided for armory personnel. Located outside the restricted area are a public toilet and an interior and exterior weapons cleaning rooms. Project will also provide rooms required to support HVAC and electrical needs. An entrance canopy will also be provided. Structural and PME work necessary to execute the job is also within the scope of the project.

1.2.2 Location

The work shall be located at the Marine Corps Air Field, Marine Corps Base, Quantico, Virginia, approximately as indicated. The exact location will be shown by the Contracting Officer.

1.3 LOCATION OF UNDERGROUND FACILITIES

Facilities Maintenance Branch is responsible for locating underground utilities or coordination with other utility providers. The Contractor

shall allow two weeks for utilities to be located by the Facilities Maintenance Branch for this project. The Contractor shall obtain digging permits prior to the start of excavation by contacting the Contracting Officer after all underground utilities have been located. Verify elevations before installing new work closer than the nearest manhole or other structure at which an adjustment in grade can be made. Perform toning where indicated or shown by the Contracting Officer.

1.3.1 Notification Prior to Excavation

Notify the Contracting Officer at least 15 days prior to starting excavation work.

1.3.2 Water Permit

The Contractor shall be required to apply to the Utilities Section, Facilities Maintenance Branch for a water permit to hook up to the water system for construction water.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01140

WORK RESTRICTIONS
03/00

PART 1 GENERAL

1.1 SPECIAL SCHEDULING REQUIREMENTS

- a. Have materials, equipment, and personnel required to perform the work at the site prior to the commencement of the work.
- b. Permission to interrupt any Activity roads, railroads, and/or utility service shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption.

1.2 CONTRACTOR ACCESS AND USE OF PREMISES

1.2.1 Activity Regulations

Ensure that Contractor personnel employed on the Activity become familiar with and obey Activity regulations including safety, fire, traffic and security regulations. Keep within the limits of the work and avenues of ingress and egress. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.

1.2.1.1 Employee List

The Contractor shall provide to the Contracting officer, in writing, the names of two designated representatives authorized to request personnel and vehicle passes for employees and subcontractor's employees prior to commencement of work under this contract. The Contractor shall adhere to the requirements of "Important Clarifications - Contractors - How to Gain Access," dated 31 October 1995, in obtaining access to the Naval Air Station complex for the life of the contract. A copy of these requirements will be provided at the preconstruction

1.2.2 Working Hours

Regular working hours shall consist of an 8 1/2 hour period established by the Contractor Officer, between 7 a.m. and 3:30 p.m., Monday through Friday, and 7 a.m. to 11 p.m. on Saturday, excluding Government holidays.

1.2.3 Work Outside Regular Hours

Work outside regular working hours requires Contracting Officer approval. Make application 15 calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number and project title. Based on the justification provided, the Contracting Officer may approve work outside regular hours. During periods

of darkness, the different parts of the work shall be lighted in a manner approved by the Contracting Officer. Make utility cutovers after normal working hours or on Saturdays, Sundays, and Government holidays unless directed otherwise.

1.2.4 Utility Cutovers and Interruptions

- a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays. Conform to procedures required in the paragraph "Work Outside Regular Hours."
- b. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.
- c. Interruption to water, sanitary sewer, storm sewer, telephone service, electric service, air conditioning, heating, fire alarm, compressed air, shall be considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours." This time limit includes time for deactivation and reactivation.

1.3 SECURITY REQUIREMENTS

Contract Clause "FAR 52.204-2, Security Requirements and Alternate II,"
"FAC 5252.236-9301, Special Working Conditions and Entry to Work Area."

1.3.1 Marine Corps Base (MCDEC), Quantico, VA

Hangars 2102 and 2103 are secured areas. The Contractor shall comply with the following security requirements.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01150

SPECIAL PROJECT PROCEDURES

03/00

PART 1 GENERAL

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 HAZARDS TO AIRFIELD HELIPORT OPERATION

In addition to "DFARS 252.236-7005, Airfield Safety Precautions," the following paragraphs apply.

3.1.1 Excavation

Open only those trenches for which material is on hand and ready for placing therein. As soon as possible after the material has been placed and work approved, backfill and the compact trenches as specified.

3.1.2 Contractor Safety Precautions

The contractor is advised that aircraft operations will produce extremely high noise levels and will induce vibrations in pavements, structures, and equipment in the vicinity, and may result in high velocity flying debris in the area. The contractor shall be responsible for providing all necessary ear protective and other safety devices for his personnel, for insuring protection of his equipment, and for scheduling the work to eliminate hazards to his personnel and equipment and to prevent damage to work performed by him.

3.1.3 Base Civil Engineering (BCE) Work Clearance Request

Obtain an approved BCE Work Clearance Request, AF Form 103, prior to the start of excavation, digging work, or work that disrupts aircraft or vehicular traffic flow, base utility services, fire and intrusion alarm system, or routine activities of the Activity.

3.2 CRANE OPERATIONS

All cranes and crane operations shall conform to OSHA 29 CFR 1910, OSHA 29 CFR 1926, and all State and local regulations.

3.2.1 Qualifications Statement

The Contractor shall provide a written qualifications statement for each crane operator to the Contracting officer for approval. The qualification statement shall include the crane operator's name, social security number and a certification and description of the crane operator's qualifications

to operate each specific crane proposed to be used. The Contractor shall allow at least ten (10) working days for approval/disapproval of each qualification statement provided. No crane operations shall begin prior to written approval of the appropriate qualifications statement by the Government.

3.2.2 Crane Work Plan

The Contractor shall provide a crane work plan to the Contracting Officer for approval. The crane work plan shall include, for each crane proposed, the specific model of crane, a drawing of all locations (exact) at which dimensions, wheel sizes, number of wheels, wheel spacing, tire pressure(s), number of axles, axle spacing, maximum wheel load to be exerted during operations and maximum outrigger load to be exerted during operations. The Contractor shall allow at least ten (10) working days for approval/disapproval of the crane work plan provided. No crane operations shall begin prior to written approval of the crane work plan by the Government.

3.2.3 Crane Operations Restrictions

The following restrictions shall apply to all crane operations in addition to previously noted regulatory requirements:

- a. Personnel shall not be lifted with a live hoist or friction crane.
- b. Wedged socket end connections shall be used to handle ammunition, hazardous material or explosive material or for lifting of personnel.

3.3 MERCURY MATERIALS

Mercury is prohibited in the construction of this facility, unless specified otherwise, and with the exception of mercury vapor lamps and fluorescent lamps. Dumping of mercury-containing materials and devices such as mercury vapor lamps, fluorescent lamps, and mercury switches, in rubbish containers is prohibited. Remove without breaking, pack to prevent breakage, and transport out of the activity in an unbroken condition for disposal as directed. Immediately report to the Contracting Officer instances of breakage or mercury spillage. Clean mercury spill area to the satisfaction of the Contracting Officer.

3.4 RESTRICTIONS ON USE OF YELLOW MATERIAL

Contractor shall refrain from use of yellow or orange-yellow materials for the following purposes: sheeting, tarpaulins, polyethylene bottles or other containers, tapes, bags, banding of identification marks on tools, boundary markers such as ribbons. Contractor generated yellow waste materials such as torn foul weather gear shall be disposed of by the Contractor off-yard. Shipyard dumpsters and trash cans shall not be used for disposal of Contractor generated yellow waste materials. Yellow colored items such as described above are of specific significance within the shipyard and are subject to strict controls.

3.5 ENTRY TO RADIOLOGICALLY CONTROLLED AREAS

Contractor personnel shall not, under any circumstances, enter a radiologically controlled area or cross any posted radiological boundary. This paragraph applies to all phases of contract work. Radiation areas are posted with signs consistent with OSHA requirements. Ensure that employees are familiar with the radiation signs and symbols. All personnel entering the shipyard for the first time are required to receive radiological indoctrination training.

Should contract workers encounter radiological postings and/or boundaries which appear to limit their ability to access or carry out their intended work, they shall notify their contract administrator for resolution of the problem.

3.5.1 Radioactive Materials and Equipment

All testing equipment, containing a radioactive source, shall be operated in accordance with an approved radioactive equipment plan. This plan shall be submitted to the Contracting Officer and approved by the Radiation Officer (Code 105.5), prior to bringing the equipment into the shipyard. This plan shall include:

- a. The name and type of equipment.
- b. The type and size of radiation source.
- c. The dates and locations of the equipment's usage.
- d. The radiological controls that the Contractor will use while operating the equipment.

A different radioactive equipment plan will be required for each different type of equipment, type of radioactive source, or size of radioactive source. A data sheet of for each piece of new radioactive equipment shall be submitted to the Contracting Officer to forward to the shipyard's Radiation Safety Officer. The data sheet shall contain the following information:

- a. Name of equipment.
- b. Name and address of equipment manufacturer.
- c. Type and size of radiation source.
- d. The location of the installed radioactive equipment (i.e. building no., floor, code/shop area).

-- End of Section --

SECTION 01200

PRICE AND PAYMENT PROCEDURES

03/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

CORPS OF ENGINEERS (COE)

COE EP-1110-1-8 (1995) Construction Equipment Ownership
and Operating Expense Schedule

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

Schedule of prices; G

1.3 SCHEDULE OF PRICES

1.3.1 Data Required

Within 15 calendar days of notice of award, prepare and deliver to the Contracting Officer a schedule of prices (construction contract) on the forms furnished by the Government. Provide a detailed breakdown of the contract price, giving quantities for each of the various kinds of work, unit prices, and extended prices therefor.

1.3.2 Schedule Instructions

Payments will not be made until the schedule of prices has been submitted to and approved by the Contracting Officer. Identify the cost for site work, and include incidental work to the 5 foot line. Identify costs for the building(s), and include work out to the 5 foot line. Work out to the 5 foot line shall include construction encompassed within a theoretical line 5 feet from the face of exterior walls and shall include attendant construction, such as cooling towers, placed beyond the 5 foot line.

1.4 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.4.1 Content of Invoice

Requests for payment will be processed in accordance with the Contract Clause "FAR 52.232-27, Prompt Payment Construction Contracts."

- a. The Contractor's invoice certified by QC, on the form furnished by the Government for this purpose, showing in summary form, the basis for arriving at the amount of the invoice. Submit original and five copies.
- b. The Contract Performance Statement on the form furnished by the Government for this purpose, showing in detail, the estimated cost, percentage of completion, and value of completed performance. Submit original and two copies.
- c. Final invoice shall be accompanied by Final Release Form. If the contractor is incorporated, the release shall contain the corporate seal. An officer of the corporation shall sign the release and the corporate secretary shall certify the release

1.5 CONTRACTOR'S INVOICE

1.5.1 Content of Invoice

Requests for payment in accordance with the terms of the contract shall consist of the following:

- a. Contractor's Invoice on NAVFAC Form 7300/41, which shall show, in summary form, the basis for arriving at the amount of the invoice.
- b. Contractor's Monthly Estimate for Voucher (LANTNAVFACENGCOM Form 4-4330/110 (New 7/84)), with subcontractor and supplier payment certification.
- c. Updated copy of submittal register.
- d. Updated copy of progress schedule. Furnish as specified in "FAR 52.236-15, Schedules for Construction Contracts."

1.5.2 Quantities of Monthly Invoices and Supporting Forms

Forms will be furnished by the Contracting Officer. Requests for payment shall be processed in accordance with "FAR 52.252-5, Payments Under Fixed-Price Construction Contracts." Monthly invoices and supporting forms for work performed through the anniversary award date of the contract shall be submitted to the Contracting Officer within 5 calendar days of the date of invoice (e.g., contract award date is the 7th of the month, the date of each monthly invoice shall be the 7th and the invoice shall be submitted by the 12th of the month) in the following quantities:

- a. Contractor's invoice - Original and five copies
- b. Contractor's monthly estimate for voucher - Original and two copies shall be required on jobs where there is a schedule of prices
- c. Affidavit - Original

- d. Updated submittal register - Two copies
- e. Progress schedule - Two copies

1.6 PAYMENTS TO THE CONTRACTOR

Payments will be made on submission of itemized requests by the Contractor which comply with the requirements of this section, and will be subject to reduction for overpayments or increase for underpayments made on previous payments to the Contractor.

- a. Basis for Contracting Officer's consideration to allow progress payment for material delivered on the site (but not installed) and for completed preparatory work, as authorized under FAR 52.232-5(b), shall be (1) major high cost items and (2) long lead special order items. Materials that will not be paid for prior to installation include, but are not limited to, bulk quantities such as nails, fasteners, conduits, gypsum board, etc. In the request for progress payment, such items shall be specifically identified in the Contractor's estimates of work submitted for the Contracting Officer's approval in accordance with paragraph entitled "Schedule of Prices" above. At the time of invoicing, the amount billed shall be supported by documents establishing its value.

1.6.1 Obligation of Government Payments

The obligation of the Government to make payments required under the provisions of this contract will, at the discretion of the Contracting Officer, be subject to reductions and/or suspensions permitted under the FAR and agency regulations including the following in accordance with "FAR 32.503-6:

- a. Reasonable deductions due to defects in material or workmanship;
- b. Claims which the Government may have against the Contractor under or in connection with this contract;
- c. Unless otherwise adjusted, repayment to the Government upon demand for overpayments made to the Contractor; and
- d. Failure to provide up to date record drawings not current as stated in Section 00711, Contract Clause "FAC 5252.236-9310, Record Drawings."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01310

ADMINISTRATIVE REQUIREMENTS
03/00

PART 1 GENERAL

1.1 REFERENCES

9The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

15 CFR 772 Individual Validated Licenses and
Amendments

15 CFR 773 Special Licensing Procedures

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

List of contact personnel; G

Insurance; G

Personnel List

Vehicle list; G

Statement of Acknowledgement Form SF 1413

1.3 MINIMUM INSURANCE REQUIREMENTS

Procure and maintain during the entire period of performance under this contract the following minimum insurance coverage:

- a. Comprehensive general liability: \$500,000 per occurrence
- b. Automobile liability: \$200,000 per person, \$500,000 per occurrence for bodily injury, \$20,000 per occurrence for property damage
- c. Workmen's compensation as required by Federal and State workers' compensation and occupational disease laws.
- d. Employer's liability coverage of \$100,000, except in States where workers compensation may not be written by private carriers,

- e. Others as required by State law.

1.4 CONTRACTOR PERSONNEL REQUIREMENTS

1.4.1 Subcontractors and Personnel

Furnish a list of contact personnel of the Contractor and subcontractors including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.4.2 Contractor Personnel Requirements

Failure to obtain entry approval will not affect the contract price or time of completion.

1.4.3 Employment Requirements

1.4.3.1 Personnel List

Submit for approval, at least 15 days prior to the desired date of entry, an original alphabetical list of personnel who require entry into Government property to perform work on the project. Furnish for each person:

- a. Name
- b. Date and place of birth
- c. Home address

1.4.3.2 Vehicle List

submit an original list of vehicles to be utilized at the work site with the following information for each vehicle:

- a. Make
- b. Year
- c. Model
- d. License number
- e. Registered owner

1.4.3.3 Passes

Submit request for personnel and vehicle passes together. Include the Certificate of Insurance for Contractor and Subcontractor(s) and the Statement of Acknowledgement Form SF 1413 with the submittal. Passes will normally be issued within 21 days.

1.5 SUPERVISION

Have at least one qualified supervisor capable of reading, writing, and conversing fluently in the English language on the job site during working hours. In addition, if a Quality Control (QC) representative is required on the contract, then that individual shall also have fluent English communication skills.

1.6 PARTNERING

The Contracting Officer intends to encourage the foundation of a cohesive partnership among the Government, the Contractor and its Subcontractors, and the Architect/Engineer. This partnership shall be structured to draw on the strengths of each organization to identify and achieve common goals.

The objectives are effective and efficient contract performance, intended to achieve completion within budget, on schedule, and in accordance with plans and specifications. The Contractor's key personnel shall attend a 2 day "partnering" course with key personnel of the Contracting Officer. Contractor key personnel are the Project Manager, Assistant Project Manager, Superintendent, QC representative, major subcontractors (electrical, mechanical, roofing, and controls), and specialized supplementary personnel. The Contractor shall organize and sponsor the course. The course will be held during normal working hours within 45 days of contract award. One day follow-up sessions will be held at 4 month intervals, or as necessary, throughout the contract, with the same participants, during normal working hours. Government reserves the option to hold a second partnering course at the mid-point of the contract.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01320

CONSTRUCTION PROGRESS DOCUMENTATION
09/99

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

Construction schedule; G

Equipment delivery schedule; G

1.2 CONSTRUCTION SCHEDULE

Within 21 days after receipt of the Notice of Award, prepare and submit to the Contracting Officer for approval a construction schedule in the form of a progress chart in accordance with the terms in Contract Clause "FAR 52.236-15, Schedules for Construction Contracts," except as modified in this contract.

1.3 EQUIPMENT DELIVERY SCHEDULE

1.3.1 Initial Schedule

Within 30 calendar days after approval of the proposed construction schedule, submit for Contracting Officer approval a schedule showing procurement plans for materials, plant, and equipment. Submit in the format and content as prescribed by the Contracting Officer, and include as a minimum the following information:

- a. Description.
- b. Date of the purchase order.
- c. Promised shipping date.
- d. Name of the manufacturer or supplier.
- e. Date delivery is expected.
- f. Date the material or equipment is required, according to the current construction schedule.

1.4 NETWORK ANALYSIS SYSTEM (NAS)

As an alternative to the preceding construction and equipment delivery schedules, the Contractor may use the critical path method (CPM) or,

subject to the approval of the Contracting Officer, some other computer generated network analysis system affording similar and equal information and control to that provided by the CPM.

1.4.1 CPM Submittals and Procedures

Submit all network analysis and updates in hard copy. Also submit CPM network schedule on 3 1/2 inch high density (1.4 MB) floppy disks. The network analysis system shall be submitted in Army Corps of Engineers Standard Data Exchange Format and be capable of running on an IBM compatible computer (IBM is a registered trademark of International Business Machines), operating with MS DOS 3.3 or later or "Windows" 3.0 or later. The network analysis system shall be kept current, with changes made to reflect the actual progress and status of the construction.

1.5 UPDATED SCHEDULES

Update the construction schedule and equipment delivery schedule at monthly intervals or when schedule has been revised. Reflect any changes occurring since the last update. Submit copies of the purchase orders and confirmation of the delivery dates as directed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01330

SUBMITTAL PROCEDURES

03/00

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Government-Furnished Information

Submittal register will be delivered to the contractor, by contracting officer. Register will have the following fields completed, to the extent that will be required by the Government during subsequent usage.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-04 Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting project requirements.

Column (f): Indicate approving authority for each submittal. A "G" indicates approval by contracting officer; a blank indicates approval by QC manager.

1.2 DEFINITIONS

1.2.1 Submittal

Shop drawings, product data, samples, and administrative submittals presented for review and approval. Contract Clauses "FAR 52.236-5, Material and Workmanship," paragraph (b) and "FAR 52.236-21, Specifications and Drawings for Construction," paragraphs (d), (e), and (f) apply to all "submittals."

1.2.2 Types of Submittals

All submittals are classified as indicated in paragraph "Submittal Descriptions (SD)". Submittals also are grouped as follows:

- a. Shop drawings: As used in this section, drawings, schedules, diagrams, and other data prepared specifically for this contract, by contractor or through contractor by way of subcontractor, manufacturer, supplier, distributor, or other lower tier contractor, to illustrate portion of work.
- b. Product data: Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams,

manufacturer's descriptive literature, catalog data, and other data to illustrate portion of work, but not prepared exclusively for this contract.

- c. Samples: Physical examples of products, materials, equipment, assemblies, or workmanship that are physically identical to portion of work, illustrating portion of work or establishing standards for evaluating appearance of finished work or both.
- d. Administrative submittals: Data presented for reviews and approval to ensure that administrative requirements of project are adequately met but not to ensure directly that work is in accordance with design concept and in compliance with contract documents.

1.2.3 Submittal Descriptions (SD)

SD-01 Preconstruction Submittals

Certificates of insurance
Surety bonds
List of proposed subcontractors
List of proposed products
Construction Progress Schedule
Submittal schedule
Schedule of values
Health and safety plan
Work plan
Quality control plan
Environmental protection plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the contractor for integrating the product or system into the project.

Drawings prepared by or for the contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports

Daily checklists

Final acceptance test and operational test procedure

SD-07 Certificates

Statements signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

Factory test reports.

SD-10 Operation and Maintenance Data

Data intended to be incorporated in operations and maintenance manuals.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

As-built drawings

Special warranties

Posted operating instructions

Training plan

1.2.4 Approving Authority

Person authorized to approve submittal.

1.2.5 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce construction and materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.3 SUBMITTALS

Submit the following in accordance with the requirements of this section.

SD-11 Closeout Submittals

Submittal register; G

1.4 USE OF SUBMITTAL REGISTER

Prepare and maintain submittal register, as the work progresses. Use electronic submittal register program furnished by the Government or any other format. Do not change data which is output in columns (c), (d), (e),

and (f) as delivered by government; retain data which is output in columns (a), (g), (h), and (i) as approved.

1.4.1 Submittal Register

Submit submittal register as an electronic database, using submittals management program furnished to contractor. Submit with quality control plan and project schedule required by Section 01450, "Quality Control". Do not change data in columns (c), (d), (e), and (f) as delivered by the government. Verify that all submittals required for project are listed and add missing submittals. Complete the following on the register:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Column (h) Contractor Approval Date: Date contractor needs approval of submittal.

Column (i) Contractor Material: Date that contractor needs material delivered to contractor control.

1.4.2 Contractor Use of Submittal Register

Update the following fields in the government-furnished submittal register program or equivalent fields in program utilized by contractor.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record contractor's review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

1.4.3 Approving Authority Use of Submittal Register

Update the following fields in the government-furnished submittal register program or equivalent fields in program utilized by contractor.

Column (b).

Column (l) List date of submittal receipt.

Column (m) through (p).

Column (q) List date returned to contractor.

1.4.4 Contractor Action Code and Action Code

Entries used will be as follows (others may be prescribed by Transmittal

Form):

NR - Not Received

AN - Approved as noted

A - Approved

RR - Disapproved, Revise, and Resubmit

1.4.5 Copies Delivered to the Government

Deliver one copy of submitted register updated by contractor to government with each invoice request. Deliver in electronic format, unless a paper copy is requested by contracting officer.

1.5 PROCEDURES FOR SUBMITTALS

1.5.1 Reviewing, Certifying, Approving Authority

QC organization shall be responsible for reviewing and certifying that submittals are in compliance with contract requirements. Approving authority on submittals is QC manager unless otherwise specified for specific submittal. At each "Submittal" paragraph in individual specification sections, a notation "G," following a submittal item, indicates contracting officer is approving authority for that submittal item.

1.5.2 Constraints

- a. Submittals listed or specified in this contract shall conform to provisions of this section, unless explicitly stated otherwise.
- b. Submittals shall be complete for each definable feature of work; components of definable feature interrelated as a system shall be submitted at same time.
- c. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without review.
- d. Approval of a separate material, product, or component does not imply approval of assembly in which item functions.

1.5.3 Scheduling

- a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential requirements to resubmit.
- b. Except as specified otherwise, allow review period, beginning with receipt by approving authority, that includes at least 15 working days for submittals for QC manager approval and 20 working days

for submittals for contracting officer approval. Period of review for submittals with contracting officer approval begins when Government receives submittal from QC organization. Period of review for each resubmittal is the same as for initial submittal.

- c. For submittals requiring review by fire protection engineer, allow review period, beginning when government receives submittal from QC organization, of 30 working days for return of submittal to the contractor. Period of review for each resubmittal is the same as for initial submittal.

1.5.4 Variations

Variations from contract requirements require Government approval pursuant to contract Clause entitled "FAR 52.236-21, Specifications and Drawings for Construction" and will be considered where advantageous to government.

1.5.4.1 Considering Variations

Discussion with contracting officer prior to submission, will help ensure functional and quality requirements are met and minimize rejections and resubmittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

1.5.4.2 Proposing Variations

When proposing variation, deliver written request to the contracting officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to government. If lower cost is a benefit, also include an estimate of the cost saving. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

1.5.4.3 Warranting That Variation Are Compatible

When delivering a variation for approval, contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.5.4.4 Review Schedule Is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Government of submittals with variations.

1.5.5 Contractor's Responsibilities

- a. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and contract documents.

- b. Transmit submittals to QC organization in accordance with schedule on approved Submittal Register, and to prevent delays in the work, delays to government, or delays to separate contractors.
- c. Advise contracting officer of variation, as required by paragraph entitled "Variations."
- d. Correct and resubmit submittal as directed by approving authority. When resubmitting disapproved transmittals or transmittals noted for resubmittal, the contractor shall provide copy of that previously submitted transmittal including all reviewer comments for use by approving authority. Direct specific attention in writing or on resubmitted submittal, to revisions not requested by approving authority on previous submissions.
- e. Furnish additional copies of submittal when requested by contracting officer, to a limit of 20 copies per submittal.
- f. Complete work which must be accomplished as basis of a submittal in time to allow submittal to occur as scheduled.
- g. Ensure no work has begun until submittals for that work have been returned as "approved," or "approved as noted" or "approved except as noted; resubmission not required", except to the extent that a portion of work must be accomplished as basis of submittal.

1.5.6 QC Organization Responsibilities

- a. Note date on which submittal was received from contractor on each submittal.
- b. Review each submittal; and check and coordinate each submittal with requirements of work and contract documents.
- c. Review submittals for conformance with project design concepts and compliance with contract documents.
- d. Act on submittals, determining appropriate action based on QC organization's review of submittal.
 - (1) When QC manager is approving authority, take appropriate action on submittal from the possible actions defined in paragraph entitled, "Actions Possible."
 - (2) When contracting officer is approving authority or when variation has been proposed, forward submittal to Government with certifying statement or return submittal marked "not reviewed" or "revise and resubmit" as appropriate. The QC organization's review of submittal determines appropriate action.
- e. Ensure that material is clearly legible.
- f. Stamp each sheet of each submittal with QC certifying statement or approving statement, except that data submitted in bound volume or

on one sheet printed on two sides may be stamped on the front of the first sheet only.

(1) When approving authority is contracting officer, QC organization will certify submittals forwarded to contracting officer with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract Number N62477-00-C-1048, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for Government approval.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Certified by QC manager _____, Date _____"
(Signature)

(2) When approving authority is QC manager, QC manager will use the following approval statement when returning submittals to contractor as "Approved" or "Approved as Noted."

"I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with contract Number N62477-00-C-1048, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is _____ approved for use.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Approved by QC manager _____, Date _____"
(Signature)

- g. Sign certifying statement or approval statement. The person signing certifying statements shall be QC organization member designated in the approved QC plan. The signatures shall be in original ink. Stamped signatures are not acceptable.
- h. Update submittal register as submittal actions occur and maintain the submittal register at project site until final acceptance of all work by contracting officer.
- i. Retain a copy of approved submittals at project site, including contractor's copy of approved samples.

1.5.7 Government's Responsibilities

When approving authority is contracting Officer, the Government will:

- a. Note date on which submittal was received from QC manager, on each submittal for which the contracting officer is approving authority.

- b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.
- c. Identify returned submittals with one of the actions defined in paragraph entitled "Actions Possible" and with markings appropriate for action indicated.

1.5.8 Actions Possible

Submittals will be returned with one of the following notations:

- a. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by contractor or for being incomplete, with appropriate action, coordination, or change.
- b. Submittals marked "approved" "approved as submitted" authorize contractor to proceed with work covered.
- c. Submittals marked "approved as noted" or "approved except as noted; resubmission not required" authorize contractor to proceed with work as noted provided contractor takes no exception to the notations.
- d. Submittals marked "revise and resubmit" or "disapproved" indicate submittal is incomplete or does not comply with design concept or requirements of the contract documents and shall be resubmitted with appropriate changes. No work shall proceed for this item until resubmittal is approved.

1.6 FORMAT OF SUBMITTALS

1.6.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels, to office of approving authority. Transmit submittals with transmittal form prescribed by contracting officer and standard for project. The transmittal form shall identify contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample panels and sample installations.

1.6.2 Identifying Submittals

Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

- a. Project title and location.

- b. Construction contract number.
- c. Section number of the specification section by which submittal is required.
- d. Submittal description (SD) number of each component of submittal.
- e. When a resubmission, alphabetic suffix on submittal description, for example, SD-10A, to indicate resubmission.
- f. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other second tier contractor associated with submittal.
- g. Product identification and location in project.

1.6.3 Format for Product Data

- a. Present product data submittals for each section as a complete, bound volume. Include table of contents, listing page and catalog item numbers for product data.
- b. Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.
- c. Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project.

1.6.4 Format for Shop Drawings

- a. Shop drawings shall not be less than 8 1/2 by 11 inches nor more than 30 by 42 inches.
- b. Present 8 1/2 by 11 inches sized shop drawings as part of the bound volume for submittals required by section. Present larger drawings in sets.
- c. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled "Identifying Submittals."
- d. Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Shop drawing dimensions shall be the same unit of measure as indicated on the contract drawings. Identify materials and products for work shown.

1.6.5 Format of Samples

- a. Furnish samples in sizes below, unless otherwise specified or

unless the manufacturer has prepackaged samples of approximately same size as specified:

- (1) Sample of Equipment or Device: Full size.
 - (2) Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.
 - (3) Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.
 - (4) Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.
 - (5) Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.
 - (6) Color Selection Samples: 2 by 4 inches.
 - (7) Sample Panel: 4 by 4 feet.
 - (8) Sample Installation: 100 square feet.
- b. Samples Showing Range of Variation: Where variations are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range.
 - c. Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples shall be in undamaged condition at time of use.
 - d. Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final clean up of project.
 - e. When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.6.6 Format of Administrative Submittals

- a. When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply contractor's approval stamp to document, but to a separate sheet accompanying document.
- b. Operation and Maintenance Manual Data: Submit in accordance with Section 01781, "Operation and Maintenance Data." Include components required in that section and the various technical sections.

1.7 QUANTITY OF SUBMITTALS

1.7.1 Number of Copies of Product Data

- a. Submit six copies of submittals of product data requiring review and approval only by QC organization and seven copies of product data requiring review and approval by contracting officer.

1.7.2 Number of Copies of Shop Drawings

Submit shop drawings in compliance with quantity requirements specified for product data.

1.7.3 Number of Samples

- a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to contractor.
- b. Submit one sample panel. Include components listed in technical section or as directed.
- c. Submit one sample installation, where directed.
- d. Submit one sample of non-solid materials.

1.7.4 Number of Copies of Administrative Submittals

- a. Unless otherwise specified, submit administrative submittals compliance with quantity requirements specified for product data.
- b. Submit administrative submittals required under "SD-19 Operation and Maintenance Manuals" to conform to Section 01781, "Operation and Maintenance Data."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01420

REFERENCES

12/98

PART 1 GENERAL

1.1 REFERENCES

Reference publications are cited in other sections of the specifications along with identification of their sponsoring organizations. The addresses of the sponsoring organizations are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)
4301 North Fairfax Drive, Suite 425
Arlington, VA 22203
Ph: 703-524-8800
Fax: 703-528-3816
internet: <http://www.ari.org>
email: ari@ari.org

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)
30 West University Drive
Arlington Heights, IL 60004-1893
Ph: 708-394-0404 (Publications)
Fax: 708-253-0088

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1827 Walden Office Square, Suite 104
Schaumburg, IL 60173-4268
Ph: 847-303-5664 (Publications)
Fax: 847-303-5774
internet: <http://www.aamanet.org>

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806
internet: <http://www.aashto.org>

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)
1 Davis Drive
P. O. Box 12215
Research Triangle Park, NC 27709-2215
Ph: 919-549-8141
Fax: 919-549-8933

AMERICAN BOILER MANUFACTURERS ASSOCIATION (ABMA)
950 North Glebe Road, Suite 160

Arlington, VA 22203-1824
Ph: 703-522-7350
Fax: 703-522-2665
<http://www.abma.com>

AMERICAN CONCRETE INSTITUTE (ACI)
P. O. Box 9094
Farmington Hills, MI 48333
Ph: 248-848-3700
Fax: 248-848-3801
internet: <http://www.aci-int.org>

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)
222 West Las Colinas Blvd, Suite 641
Irving, TX 75039-5423
Ph: 972-506-7126
Fax: 972-506-7682
internet: <http://www.concrete-pipe.org>
email: info@concrete-pipe.org

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Drive
Cincinnati, OH 45240
Ph: 513-742-2020
Fax: 513-742-3355
internet: <http://www.acgih.org>

AMERICAN FOREST & PAPER ASSOCIATION (AFPA)
1111 Nineteenth Street, NW, Suite 800
Washington, DC 20036
Ph: 202-463-2766
Fax: 202-463-2791
internet: <http://www.awc.org>
email: awcinfo@afandpa.org

AMERICAN GAS ASSOCIATION (AGA)
1515 Wilson Boulevard
Arlington, VA 22209
Ph: 703-841-8400
Fax: 703-841-8406
internet: <http://www.aga.com>

AMERICAN GEAR MANUFACTURERS ASSOCIATION, INC. (AGMA)
1500 King Street, Suite 201
Alexandria, VA 22314-2730
Ph: 703-684-0211
Fax: 703-684-0242
Order from:
Global Engineering Documents
15 Inverness Lane East
Englewood, CO 80112
Ph: 800-854-7179
Fax: 303-397-2740

AMERICAN HARDBOARD ASSOCIATION (AHA)
1210 West Northwest Highway
Palatine, IL 60067
Ph: 708-934-8800
Fax: 708-934-8803

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Drive, Suite 3100
Chicago, IL 60601-2001
Ph: 312-670-2400/800-644-2400
Fax: 312-670-5403
internet: <http://www.aiscweb.com>

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)
7012 South Revere Parkway, Suite 140
Englewood, CO 80112
Ph: 303-792-9559
Fax: 303-792-0669

AMERICAN IRON AND STEEL INSTITUTE (AISI)
Publication ordering:
P. O. Box 4327
Chestertwon, MD 21690
Ph: 800-277-3850
Fax: 410-810-0910
internet: <http://www.steel.org>

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
11 West 42nd Street
New York, NY 10036
Ph: 212-642-4900
Fax: 212-398-0023
internet: <http://www.ansi.org>

AMERICAN PETROLEUM INSTITUTE (API)
1220 "L" Street, NW
Washington, DC 20005
Ph: 202-682-8375
Fax: 202-962-4776
internet: <http://www.api.org>

AMERICAN PUBLIC HEALTH ASSOCIATION (APHA)
1015 Fifteenth Street, NW, Suite 300
Washington, DC 20005
Ph: 202-789-5600
Fax: 202-789-5661
internet: <http://www.apha.org>

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)
50 "F" Street, NW
Washington, DC 20001
Ph: 202-639-2100/2122
Fax: 202-639-2986

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING, INC. (ASNT)
1711 Arlingate Lane
P. O. Box 28518
Columbus, OH 43228-0518
Ph: 800-222-2768
Fax: 614-274-6899

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Ph: 610-832-9585
Fax: 610-832-9555
internet: <http://www.astm.org>
email: cservice@astm.org

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191-4400
Ph: 703-295-6300
Fax: 703-295-6444
internet: <http://www.asce.org>

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING
ENGINEERS, INC. (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329-2305
Ph: 404-636-8400/800-527-4723
Fax: 404-321-5478
internet: <http://www.ashrae.org>

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
345 East 47th Street
New York, NY 10017
Ph: 212-705-7722
Fax: 212-705-7739
internet: <http://www.asme.org>

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)
28901 Clemens Road
Westlake, OH 44145
Ph: 440-835-3040
Fax: 440-835-3488
email: asse@ix.netcom.com

AMERICAN SOD PRODUCERS ASSOCIATION (ASPA)
1855-A Hicks Road
Rolling Meadows, IL 60008
Ph: 847-705-9898
Fax: 847-705-8347
internet: <http://turfgrasssod.org>

AMERICAN WATER WORKS ASSOCIATION (AWWA)
6666 West Quincy Avenue
Denver, CO 80235

Ph: 303-794-7711
Fax: 303-794-7310
internet: <http://www.awwa.org>
email: bookstor@awwa.org

AMERICAN WELDING SOCIETY, INC. (AWS)
550 NW LeJeune Road
Miami, FL 33126
Ph: 305-443-9353/800-334-9353
Fax: 305-443-7559
internet: <http://www.amweld.org>

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)
3246 Fall Creek Highway, Suite 1900
Grandbury, TX 76049-7979
Ph: 817-326-6300
Fax: 817-326-6306

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)
1200 19th Street, NW
Washington, DC 20036
Ph: 202-429-5155
Fax: 202-223-4579

APA - THE ENGINEERED WOOD ASSOCIATION (APA)
P. O. Box 11700
Tacoma, WA 98411-0700
Ph: 253-565-6600
Fax: 253-565-7265
internet: <http://www.apawood.org>

ARCHITECTURAL & TRANSPORTATION BARRIERS COMPLIANCE BOARD (ATBCB)
1331 F. Street N.W., Suite 1000
Washington, DC 20004-1111
Ph: 800-872-2253
Fax: 202-272-5447
internet: <http://www.access.board>

ARCHITECTURAL WOODWORK INSTITUTE (AWI)
1952 Isaac Newton Square
Reston, VA 20190
Ph: 703-733-0600
Fax: 703-733-0584
internet: <http://www.awinet.org>

ASPHALT INSTITUTE (AI)
Research Park Drive
P. O. Box 14052
Lexington, KY 40512-4052
Ph: 606-288-4960
Fax: 606-288-4999
internet: <http://www.asphaltinstitute.org>
email: asphalt@asphaltinstitute.org

ASSOCIATED AIR BALANCE COUNCIL (AABC)
1518 "K" Street, NW, Suite 503
Washington, DC 20005
Ph: 202-737-0202
Fax: 202-638-4833

ASSOCIATED GENERAL CONTRACTORS OF AMERICA (AGCA)
1957 E. Street, N.W.
Washington, DC 20006
Ph: 202-393-2040
Fax: 202-347-4004
internet: <http://www.agca.org>
Email: info@agc.org

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
600 North 18th Street
P. O. Box 2641
Birmingham, AL 35291-0992
Ph: 205-250-2530
Fax: 205-250-2540
internet: <http://www.aeic.org>
email: veazey-white@apc.com

ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)
20 North Wacker Drive, Suite 1500
Chicago, IL 60606
Ph: 312-984-5800
Fax: 312-984-5823
internet: <http://www.aham.org>

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION, INC. (BHMA)
355 Lexington Avenue, 17th Floor
New York, NY 10017
Ph: 212-661-4261
Fax: 212-370-9047
internet: <http://www.buildershardware.com>

CANADIAN STANDARDS ASSOCIATION (CAN/CSA)
178 Rexdale Blvd.
Rexdale (Toronto), ON
M9WIR3
Ph: 416-747-4000/800-463-6727
Fax: 416-747-4149
internet: <http://www.csa.ca>
email: sales@csa.ca

CARPET AND RUG INSTITUTE (CRI)
310 Holiday Ave.
P. O. Box 2048
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Ph: 202-720-8674
Fax: 202-720-1915

SCREEN MANUFACTURERS ASSOCIATION (SMA)
2950 South Ocean Blvd., Suite 311
Palm Beach, FL 33480-5535
Ph: 407-533-0991
Fax: 407-533-7466

SEALED INSULATING GLASS MANUFACTURERS ASSOCIATION (SIGMA)
401 North Michigan Avenue
Chicago, IL 60611
Ph: 312-644-6610
Fax: 312-321-6869

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION,
INC. (SMACNA)
4201 Lafayette Center Drive
Chantilly, VA 20151-1209
Ph: 703-803-2980
Fax: 703-803-3732
internet: <http://www.smacna.org>

email: info@smacna.org

SINGLE-PLY ROOFING INSTITUTE (SPRI)
200 Reservoir Street, Suite 309A
Needham, MA 02494
Ph: 781-444-0242
Fax: 781-444-6111
internet: <http://www.spri.org>
email: spri@spri.org

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)
400 Commonwealth Drive
Warrendale, PA 15096-0001
Ph: 724-776-4841
Ph: 724-776-5760
internet: <http://www.sae.org>
email: publications.sae.org

SOCIETY OF MOTION PICTURE & TELEVISION ENGINEERS (SMPTE)
595 West Hartsdale Avenue
White Plains, NY 10607
Ph: 914-761-1100
Fax: 914-761-3115

SOCIETY OF THE PLASTICS INDUSTRY, INC. (SPI)
1801 K Street, NW, Suite 600K
Washington, DC 20006-1301
Ph: 202-974-5200
Fax: 202-296-7005
internet: <http://www.socplas.org>
email: feedback@socplas.org

SOLAR RATING AND CERTIFICATION CORPORATION (SRCC)
c/o FSEC
1679 Clearlake Road
Cocoa, FL 32922-5703
Ph: 407-638-1537
Fax: 407-638-1010
internet: <http://www.theenergyguy.com/energyguy/srcc.html>
email: srcc@fsec.icf.edu

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)
400 Penn Center Boulevard, Suite 530
Pittsburgh, PA 15235
Ph: 412-829-0770
Fax: 412-829-0844

SOUTHERN PINE INSPECTION BUREAU (SPIB)
4709 Scenic Highway
Pensacola, FL 32504-9094
Ph: 850-434-2611
Fax: 850-433-5594
internet: <http://www.spib.org>
email: spib@spib.org

STEEL DECK INSTITUTE (SDEI)

P. O. Box 25
Fox River Grove, IL 60021-0025
Ph: 847-462-1930
Fax: 847-462-1940
internet: <http://www.sdi.org>
email: steve@sdi.org

STEEL DOOR INSTITUTE (SDI)

30200 Detroit Road
Cleveland, OH 44145-1967
Ph: 440-899-0010
Fax: 440-892-1404
internet: <http://www.wherryassoc.com/steeldoors.org>

STEEL JOIST INSTITUTE (SJI)

3127 10th Avenue, North
Myrtle Beach, SC 29577-6760
Ph: 803-626-1995
Fax: 803-626-5565

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

40 24th Street
Pittsburg, PA 15222
Ph: 412-281-2331
Fax: 412-281-9992

STEEL TANK INSTITUTE (STI)

570 Oakwood Road
Lake Zurich, IL 60047
Ph: 847-438-8265
Fax: 847-438-8766
internet: <http://www.steeltank.com>

STEEL WINDOW INSTITUTE (SWI)

Order from:
Thomas Associates, Inc.
1300 Sumner Avenue
Cleveland, OH 44115-2851
Ph: 216-241-7333
Fax: 216-241-0105

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

If using UPS:
15 Technology Parkway South
Norcross, GA 30092
Ph: 770-446-1400/800-332-8686
Fax: 770-446-6947
If ordering by mail:
Service Department
P. O. Box 105113
Atlanta, GA 30348-5113

THE ALUMINUM ASSOCIATION, INCORPORATED (AA)
900 19th Street, NW
Washington, DC 20006
Ph: 202-862-5100
Fax: 202-862-5164
internet: <http://www.aluminum.org>

TRUSS PLATE INSTITUTE (TPI)
583 D'Onofrio Drive, Suite 200
Madison, WI 53719
Ph: 608-833-5900
Fax: 608-833-4360

TUBULAR EXCHANGER MANUFACTURERS ASSOCIATION (TEMA)
25 North Broadway
Tarrytown, NY 10591
Ph: 914-332-0040
Fax: 914-332-1541

UNDERWRITERS LABORATORIES INC. (UL)
333 Pfingsten Road
Northbrook, IL 60062-2096
Ph: 847-272-8800
Fax: 847-272-8129
internet: <http://www.ul.com>
email: northbrook@ul.com

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)
2655 Villa Creek Drive, Suite 155
Dallas, TX 75234
Ph: 214-243-3902
Fax: 214-243-3907

UNITED STATES CODE (USC)
Superintendent of Documents
P. O. Box 371954
Pittsburg, PA 15250-7954
Ph: 202-512-1800
Fax: 202-512-2250
internet: http://www.access.gpo.gov/su_docs

UNIVERSITY OF CALIFORNIA DIVISION OF AGRICULTURE AND NATURAL
RESOURCES (UCDANR)
Agricultural Publication
6701 San Pablo Avenue
Oakland, CA 94608-1239
Ph: 510-642-2431
Fax: 510-643-5470

U.S. DEPARTMENT OF COMMERCE PRODUCT STANDARDS (PS)
Superintendent of Documents
P. O. Box 371954
Pittsburg, PA 15250-7954

Ph: 202-512-1800
Fax: 202-512-2250
internet: http://www.access.gpo.gov/su_docs

VIRGINIA ADMINISTRATIVE CODE (VAC)
Department of Professional and Occupational Regulations
3600 West Broad Street
Richmond, VA 23230-4917
Ph: 804-367-8595

VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION (VDHT)
1401 East Broad Street
Richmond, VA 23219-2094
Ph: 804-786-2801
Fax: 804-786-6250

VIRGINIA SOIL AND WATER CONSERVATION COMMISSION (VSWCC)
203 Governor Street, Suite 206
Richmond, VA 23219-2094
Ph: 804-786-2064
Fax: 804-786-1798

VIRGINIA STATE REGULATIONS (VSR)
Department of Environment Quality
629 Main East Street
Richmond, VA 23240
Ph: 804-698-4000
Fax: 804-698-4500

WASHINGTON STATE ADMINISTRATIVE CODE (WAC)
P. O. BOX 47600
Olympia, WA 98504-7600
Ph: 360-407-6045 (Records)
Fax: 360-407-6137

WASHINGTON STATE DEPARTMENT OF ECOLOGY (WSDE)
P. O. Box 47600
Olympia, WA 98504-7600
Ph: 360-407-7472 (Publications)
Fax: 360-407-6035

WATER QUALITY ASSOCIATION (WQA)
4151 Naperville Road
Lisle, IL 60532
Ph: 630-505-0160
Fax: 630-505-9637
internet: <http://www.wqa.org>
email: info@mail.wqa.org

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)
6980 SW Varns Street
Portland, OR 97223
Ph: 503-639-0651
Fax: 503-684-8928

Ordering address:
P. O. Box 23145
Portland, OR 97281

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)
522 SW 5th Avenue, Suite 500
Portland, OR 97204-2122
Ph: 503-224-3930
Fax: 503-224-3934
internet: <http://www.wwpa.org>
email: info@wwpa.org

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01450

QUALITY CONTROL
03/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 880	(1995) Criteria for Use in Evaluation of Testing Laboratories and Organization for Examination and Inspection of Steel, Stainless Steel, and Related Alloys
ASTM C 1077	(1997) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 3666	(1996) Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
ASTM D 3740	(1996) Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(1995; Rev. C) Agencies Engaged in the Testing and/or Inspection of Materials Used on Construction
ASTM E 543	(1996) Agencies Performing Nondestructive Testing

CORPS OF ENGINEERS (COE)

COE EM-385-1-1	(1996) Safety and Health Requirements Manual
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1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

Quality Control (QC) plan; G

Submit a QC plan within 20 calendar days after receipt of Notice of Award.

1.3 INFORMATION FOR THE CONTRACTING OFFICER

Prior to commencing work on construction, the Contractor can obtain a single copy set of the current report forms from the Contracting Officer, or by calling the local EFA/EFD QA Coordinator for an electronic version of the report forms. The report forms will consist of the Contractor Production Report, Contractor Production Report (Continuation Sheet), Contractor Quality Control Report, Contractor Quality Control Report (Continuation Sheet), Preparatory Phase Checklist, Initial Phase Checklist, Rework Items List, and Testing Plan and Log. Other reports referenced below may be in formats customarily used by the Contractor, Testing Laboratories, etc. and will contain the information required by this specification.

Deliver the following to the Contracting Officer:

- a. Combined Contractor Production Report/Contractor Quality Control Report (1 sheet): Original and 1 copy , by 10:00 AM the next working day after each day that work is performed;
- b. Preparatory Phase Checklist: Original attached to the original Combined Contractor Production Report/Contractor Quality Control Report and 1 copy attached to each copy.
- c. Initial Phase Checklist: Original attached to the original Combined Contractor Production Report/Contractor Quality Control Report and 1 copy attached to each copy.
- d. QC specialist Reports: Originals and 2, by 10:00 AM the next working day after each day that work is performed, attached to the Contractor Quality Control Report;
- e. Field Test Reports: 2 copies, within 2 working days after the test is performed, attached to the Contractor Quality Control Report;
- f. Monthly Summary Report of Tests: 2 copies attached to the Contractor Quality Control Report;
- g. Testing Plan and Log, 2 copies, at the end of each month;
- h. Rework Items List: 2 copies, by the last working day of the month
- i. QC Meeting Minutes: 2 copies, within 2 working days after the meeting and;
- j. QC Certifications: As required by the paragraph entitled "QC Certifications."

1.4 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Organization, a QC Plan, a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and approval, testing, completion inspections, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this Contract. The QC program shall cover on-site and off-site work and shall be keyed to the work sequence. No work or testing may be performed unless the QC Manager is on the work site. The project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with quality requirements specified in the contract. The project superintendent in this context shall mean the individual with the responsibility for the overall management of the project including quality and production.

1.4.1 Preliminary Work Authorized Prior to Approval

The only work that is authorized to proceed prior to the approval of the QC Plan is mobilization of storage and office trailers, temporary utilities, and surveying.

1.4.2 Approval

Approval of the QC Plan is required prior to the start of construction. The Contracting Officer reserves the right to require changes in the QC Plan and operations as necessary, including removal of personnel, to ensure the specified quality of work. The Contracting Officer reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications. All QC organization personnel shall be subject to acceptance by the Contracting Officer.

1.4.3 Notification of Changes

Notify the Contracting Officer, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes shall be subject to acceptance by the Contracting Officer.

1.5 QC ORGANIZATION

1.5.1 QC Manager

1.5.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. The only duties and responsibilities of the QC Manager are to manage and implement the QC program on this contract. The QC Manager is required to attend the QC Plan meeting, attend the Coordination and Mutual Understanding Meeting, conduct the QC meetings, perform the three phases of control, perform submittal review and approval, ensure testing is performed and provide QC certifications and documentation required in this contract. The QC Manager is responsible for managing and coordinating the

three phases of control and documentation performed by Testing Laboratory personnel and any other inspection and testing personnel required by this Contract.

1.5.1.2 Qualifications

A graduate of a four year accredited college program in one of the following disciplines: Engineering, Architecture, Construction Management, Engineering Technology, Building Construction, or Building Science, with a minimum of 2 years experience as a superintendent, inspector, QC Manager, project manager, or construction manager on similar size and type construction contracts which included the major trades that are part of this Contract. The individual must be familiar with the requirements of COE EM-385-1-1, and have experience in the areas of hazard identification and safety compliance.

1.5.1.3 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager shall have completed the course entitled "Construction Quality Management for Contractors." The course is offered by the following organizations in the Washington, DC area:

The Army Corps of Engineers, Baltimore District;
(Offered in Baltimore, MD)
Contact: Corps of Engineers, Baltimore District
10 South Howard Street
Baltimore, MD 21201
Phone: 410-962-2323

The Associated General Contractors (AGC), Virginia Chapter
in Cooperation with the Army Corps of Engineers, Norfolk District, and
the Naval Facilities Engineering Command, Atlantic Division.
(Offered at rotating locations in Norfolk, Williamsburg, and Richmond)
Contact: AGC of Virginia
8631 Maylan Drive, Parham Park
Richmond, VA 23294
Phone: 804-346-3383

1.6 QUALITY CONTROL (QC) PLAN

1.6.1 Requirements

Provide, for approval by the Contracting Officer, a QC plan submitted in a 3-ring binder with pages numbered sequentially that covers both on-site and off-site work and includes the following:

- a. A table of contents listing the major sections identified with tabs in the following order:
 - I. QC ORGANIZATION
 - II. NAMES AND QUALIFICATIONS
 - III. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL
 - IV. OUTSIDE ORGANIZATIONS

- V. APPOINTMENT LETTERS
 - VI. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER
 - VII. TESTING LABORATORY INFORMATION
 - VIII. TESTING PLAN AND LOG
 - IX. PROCEDURES TO COMPLETE REWORK ITEMS
 - X. DOCUMENTATION PROCEDURES
 - XI. LIST OF DEFINABLE FEATURES
 - XII. PROCEDURES FOR PERFORMING THE THREE PHASES OF CONTROL
-
- b. A chart showing the QC organizational structure.
 - c. Names and qualifications, in resume format, for each person in the QC organization.
 - d. Duties, responsibilities and authorities of each person in the QC organization.
 - e. A listing of outside organizations such as, architectural and consulting engineering firms that will be employed by the Contractor and a description of the services these firms will provide.
 - f. Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager and stating that they are responsible for implementing and managing the QC program as described in this contract. Include in this letter the responsibility of the QC Manager and Alternate QC Manager to implement and manage the three phases of quality control, and their authority to stop work which is not in compliance with the contract. The QC Manager shall issue letters of direction to all other QC specialists outlining their duties, authorities, and responsibilities. Copies of the letters shall be included in the QC plan.
 - g. Procedures for reviewing, approving and managing submittals. Provide the name of the person in the QC organization authorized to review and certify submittals prior to approval. Provide the initial submittal of the Submittal Register as specified in section entitled "Submittal Procedures."
 - h. Testing laboratory information required by the paragraphs entitled "Accredited Laboratories" or "Testing Laboratory Requirements", as applicable.
 - i. A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test.
 - j. Procedures to identify, record, track and complete rework items.
 - k. Documentation procedures, including proposed report formats.
 - l. List of definable features of work. A definable feature of work (DFOW) is a task which is separate and distinct from other tasks and requires separate quality control requirements. A DFOW could

be identified by different trades or disciplines or by an item or activity on the construction schedule. Although each specification section could be considered a definable feature of work there frequently is more than one definable feature of work under a particular section. The list shall be cross-referenced to the contractor's Construction Schedule and the specification sections. For projects requiring a Progress Chart, the list of definable features of work shall include but not be limited to all items of work on the schedule. For projects requiring a Network Analysis System, the list of definable features of work shall include but not be limited to all critical path activities.

1.7 QC PLAN MEETING

Prior to submission of the QC plan, meet with the Contracting Officer to discuss the QC plan requirements of this Contract. The purpose of this meeting is to develop a mutual understanding of the QC plan requirements prior to plan development and submission.

1.8 QC MEETINGS

After the start of construction, the QC Manager shall conduct QC meetings once every two weeks at the work site with the project superintendent. The QC Manager shall prepare the minutes of the meeting and provide a copy to the Contracting Officer within 2 working days after the meeting. The Contracting Officer may attend these meetings. The QC Manager shall notify the Contracting Officer at least 48 hours in advance of each meeting. As a minimum, the following shall be accomplished at each meeting:

- a. Review the minutes of the previous meeting;
- b. Review the schedule and the status of work:
 - (1) Work or testing accomplished since last meeting
 - (2) Rework items identified since last meeting
 - (3) Rework items completed since last meeting;
- c. Review the status of submittals:
 - (1) Submittals reviewed and approved since last meeting
 - (2) Submittals required in the near future;
- d. Review the work to be accomplished in the next 2 weeks and documentation required:
 - (1) Establish completion dates for rework items
 - (2) Update the schedule showing planned and actual dates of the preparatory, initial and follow-up phases, including testing and any other inspection required by this contract

- (3) Discuss construction methods and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each definable feature of work
- (4) Discuss status of off-site work or testing
- (5) Documentation required;
- (6) Discuss upcoming Activity Hazard Analyses:
- e. Resolve QC and production problems:
 - (1) Assist in resolving Request for Information issues; and
- f. Address items that may require revising the QC plan:
 - (1) Changes in QC organization personnel
 - (2) Changes in procedures.
- g. Review health and safety plan

1.9 THREE PHASES OF CONTROL

The Three Phases of Control shall adequately cover both on-site and off-site work and shall include the following for each definable feature of work.

1.9.1 Preparatory Phase

Notify the Contracting Officer at least 2 work days in advance of each preparatory phase. This phase shall include a meeting conducted by the QC Manager and attended by the superintendent, and the foreman responsible for the definable feature. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report and in the Preparatory Phase Checklist. Perform the following prior to beginning work on each definable feature of work:

- a. Review each paragraph of the applicable specification sections;
- b. Review the Contract drawings;
- c. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required;
- d. Review the testing plan and ensure that provisions have been made to provide the required QC testing;
- e. Examine the work area to ensure that the required preliminary work has been completed;
- f. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop

drawings and submitted data;

- g. Discuss construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each definable feature of work; and
- h. Review the safety plan and appropriate activity hazard analysis to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted.

1.9.2 Initial Phase

Notify the Contracting Officer at least 2 work days in advance of each initial phase. When construction crews are ready to start work on a definable feature of work, conduct the initial phase with , the superintendent, and the foreman responsible for that definable feature of work. Observe the initial segment of the definable feature of work to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily Contractor Quality Control Report and in the Initial Phase Checklist. Repeat the initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. Perform the following for each definable feature of work:

- a. Establish the quality of workmanship required;
- b. Resolve conflicts;
- c. Ensure that testing is performed by the approved laboratory, and
- d. Check work procedures for compliance with the Safety Plan and the appropriate activity hazard analysis to ensure that applicable safety requirements are met.

1.9.3 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary until the completion of each definable feature of work and document in the daily Contractor Quality Control Report:

- a. Ensure the work is in compliance with Contract requirements;
- b. Maintain the quality of workmanship required;
- c. Ensure that testing is performed by the approved laboratory;
- d. Ensure that rework items are being corrected; and
- e. Perform safety inspections.

1.9.4 Additional Preparatory and Initial Phases

Additional Preparatory and Initial Phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable,

if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a definable feature is resumed after substantial period of inactivity, or if other problems develop.

1.9.5 Notification of Three Phases of Control for Off-Site Work

Notify the Contracting Officer at least two weeks prior to the start of the preparatory and initial phases.

1.10 SUBMITTAL REVIEW AND APPROVAL

Procedures for submission, review and approval of submittals are described in section entitled "Submittal Procedures."

1.11 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this Contract.

1.11.1 Accreditation Requirements

Construction materials testing laboratories performing work for Navy construction contracts will be required to submit one of the following:

- a. A copy of the Certificate of Accreditation and Scope of Accreditation by an acceptable laboratory accreditation authority, or
- b. An acknowledgment letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started.

Construction materials testing laboratories performing work for Navy construction contracts must be accredited by one of the laboratory accreditation authorities. The laboratory's scope of accreditation must include the ASTM standards listed in the paragraph titled "Construction Materials Testing Laboratory Requirements" as appropriate to the testing field. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office".

1.11.2 Construction Materials Testing Laboratory Requirements

Provide an independent construction materials testing laboratory accredited by an acceptable laboratory accreditation authority to perform sampling and tests required by this Contract. Testing laboratories that have obtained accreditation by an acceptable laboratory accreditation authority listed in the paragraph entitled "Laboratory Accreditation Authorities" submit to the Contracting Officer, a copy of the Certificate of Accreditation and Scope of Accreditation. The scope of the laboratory's accreditation shall include the test methods required by the Contract. For testing laboratories that have not yet obtained accreditation by an acceptable laboratory accreditation authority listed in the paragraph entitled "Laboratory Accreditation Authorities" submit an acknowledgment

letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started, and submit to the Contracting Officer for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.

- a. Laboratories engaged in testing of construction materials shall meet the requirements of ASTM E 329.
- b. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C 1077.
- c. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D 3666.
- d. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, shall meet the requirements of ASTM D 3740.
- e. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A 880.
- f. Laboratories engaged in nondestructive testing (NDT) shall meet the requirements of ASTM E 543.
- g. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA.

1.11.3 Laboratory Accreditation Authorities

Laboratory Accreditation Authorities are the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology, the American Association of State Highway and Transportation Officials (AASHTO) program, and the American Association for Laboratory Accreditation (A2LA) program and the Washington Association of Building Officials (WABO) (Approval authority for WABO is limited to projects within Washington State), and the Washington Area Council of Engineering Laboratories (WACEL) (Approval authority by WACEL is limited to projects within the Chesapeake Division and Public Works Center Washington geographical area).

Furnish to the Contracting Officer, a copy of the Certificate of Accreditation and Scope of Accreditation. The scope of the laboratory's accreditation shall include the test methods required by the Contract.

1.11.4 Capability Check

The Contracting Officer retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract.

1.11.5 Test Results

Cite applicable Contract requirements, tests or analytical procedures used.

Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify Contracting Officer immediately.

Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results shall be signed by a testing laboratory representative authorized to sign certified test reports.

Furnish the signed reports, certifications, and other documentation to the Contracting Officer via the QC Manager. Furnish a summary report of field tests at the end of each month. Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month.

1.11.6 Test Reports and Monthly Summary Report of Tests

The QC Manager shall furnish the signed reports, certifications, and a summary report of field tests at the end of each month to the Contracting Officer. Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month.

1.12 QC CERTIFICATIONS

1.12.1 Contractor Quality Control Report Certification

Each Contractor Quality Control Report shall contain the following statement: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge, except as noted in this report."

1.12.2 Invoice Certification

Furnish a certificate to the Contracting Officer with each payment request, signed by the QC Manager, attesting that as-built drawings are current and attesting that the work for which payment is requested, including stored material, is in compliance with contract requirements.

1.12.3 Completion Certification

Upon completion of work under this Contract, the QC Manager shall furnish a certificate to the Contracting Officer attesting that "the work has been completed, inspected, tested and is in compliance with the Contract."

1.13 COMPLETION INSPECTIONS

1.13.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the FAR clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the QC Manager shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved

drawings and specifications. Include in the punch list any remaining items on the "Rework Items List" which were not corrected prior to the Punch-Out Inspection. The punch list shall include the estimated date by which the deficiencies will be corrected. A copy of the punch list shall be provided to the Contracting Officer. The QC Manager or staff shall make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished the Contractor shall notify the Government that the facility is ready for the Government "Pre-Final Inspection."

1.13.2 Pre-Final Inspection

The Government will perform this inspection to verify that the facility is complete and ready to be occupied. A Government "Pre-Final Punch List" may be developed as a result of this inspection. The QC Manager shall ensure that all items on this list are corrected prior to notifying the Government that a "Final" inspection with the customer can be scheduled. Any items noted on the "Pre-Final" inspection shall be corrected in timely manner and shall be accomplished within the time slated for completion of the entire work, or any particular increment thereof if the project is divided into increments by separate completion dates.

1.13.3 Final Acceptance Inspection

The QC Manager, the QC specialists, the superintendent or other primary contractor management personnel, and the Contracting Officer's representative will be in attendance at this inspection. Additional Government personnel may be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the "Pre-Final" inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final inspection stating that all specific items previously identified to the Contractor as being unacceptable, along with all the remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction."

1.14 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities.

1.14.1 Contractor Production Report

Reports are required for each day that work is performed and shall be attached to the Contractor Quality Control Report prepared for the same day. Account for each calendar day throughout the life of the Contract. The reporting of work shall be identified by terminology consistent with the construction schedule. Contractor Production Reports are to be prepared, signed and dated by the project superintendent and shall contain the following information:

- a. Date of report, report number, name of contractor, Contract number, title and location of Contract and superintendent present.
- b. Weather conditions in the morning and in the afternoon including maximum and minimum temperatures.
- c. Identify work performed by corresponding Schedule Activity No., PC#, Modification No., etc.
- d. A list of Contractor and subcontractor personnel on the work site, their trades, employer, work location, description of work performed, hours worked by trade, daily total work hours on work site this date (incl hours on continuation sheets), and total work hours from start of construction.
- e. A list of job safety actions taken and safety inspections conducted. Indicate that safety requirements have been met including the results on the following:
 - (1) Was a job safety meeting held this date? (If YES, attach a copy of the meeting minutes.)
 - (2) Were there any lost time accidents this date? (If YES, attach a copy of the completed OSHA report.)
 - (3) Was crane/manlift/trenching/scaffold/hv electrical/high work/hazmat work done? (If YES, attach a statement or checklist showing inspection performed.)
 - (4) Was hazardous material/waste released into the environment? (If YES, attach a description of incident and proposed action.)
- f. Identify Schedule Activity No. related to safety action and list safety actions taken today and safety inspections conducted.
- g. Identify Schedule Activity No., Submittal # and list equipment/material received each day that is incorporated into the job.
- h. Identify Schedule Activity No., Owner and list construction and plant equipment on the work site including the number of hours used.
- i. Include a "remarks" section in this report which will contain pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site. For each remark given, identify the Schedule Activity No. that is associated with the remark.

1.14.1.1 Contractor Production Report (Continuation Sheet)

Additional space required to contain daily information on the Contractor Production Report will be placed on its Continuation Sheet(s). An unlimited number of Continuation Sheets may be added as necessary and attached to the Production Report.

1.14.2 Contractor Quality Control Report

Reports are required for each day that work is performed and for every seven consecutive calendar days of no-work and on the last day of a no-work period. Account for each calendar day throughout the life of the Contract.

The reporting of work shall be identified by terminology consistent with the construction schedule. Contractor Quality Control Reports are to be prepared, signed and dated by the QC Manager and shall contain the following information:

- a. Date of report, report number, Contract Number, and Contract Title.
- b. Indicate if Preparatory Phase work was performed today (Yes/No check boxes).
- c. If Preparatory Phase work was performed today (including on-site and off-site work), identify its Schedule Activity No. and Definable Feature of Work. The Index # is a cross reference to the Preparatory Phase Checklist. An example of the Index # is: 0025-P01, where "0025" is the Contractor Quality Control Report Number, "P" indicates Preparatory Phase, and "01" is the Preparatory Phase Checklist number(s) for this date. Each entry in this section must be accompanied with a corresponding Preparatory Phase Checklist.
- d. Indicate if Initial Phase work was performed today (Yes/No check boxes).
- e. If Initial Phase work was performed today (including on-site and off-site work), identify its Schedule Activity No. and Definable Feature of Work. The Index # is a cross reference to the Initial Phase Checklist. An example of the Index # is: 0025-I01, where "0025" is the Contractor Quality Control Report Number, "I" indicates Initial Phase, and "01" is the Initial Phase Checklist number(s) for this date. Each entry in this section must be accompanied with a corresponding Initial Phase Checklist.
- f. Results of the Follow-up Phase inspections held today (including on-site and off-site work), including Schedule Activity No., the location of the definable feature of work, Specification Sections, etc. Indicate in the report for this definable feature of work that the work complies with the Contract as approved in the Initial Phase, work complies with safety requirements, and that required testing has been performed and include a list of who performed the tests.
- g. List the rework items identified, but not corrected by close of business; along with its associated Schedule Activity Number.

- h. List the rework items corrected from the rework items list along with the corrective action taken and its associated Schedule Activity Number.
- i. Include a "remarks" section in this report which will contain pertinent information including directions received, quality control problem areas, deviations from the QC plan, construction deficiencies encountered, QC meetings held, acknowledgement that as-built drawings have been updated, corrective direction given by the QC Organization and corrective action taken by the Contractor. For each remark given, identify the Schedule Activity No. that is associated with the remark.
- j. Contractor Quality Control Report certification, signature and date.

1.14.2.1 Contractor Quality Control Report (Continuation Sheet)

Additional space required to contain daily information on the Contractor Quality Control Report will be placed on its Continuation Sheet(s). An unlimited number of Continuation Sheets may be added as necessary and attached to the Contractor Quality Control Report.

1.14.3 Preparatory Phase Checklist

Each Definable Feature of Work that is in the Preparatory Phase shall have this checklist filled out for it. The checklist shall be identified by terminology consistent with the construction schedule. Attach this checklist to the Contractor Quality Control Report of the same date.

- a. Specification Section, date of report, and Contract number shall be filled out. Duplicate this information in the header of the second page of the report.
- b. Definable Feature of Work, Schedule Activity No. and Index # entry and format will match entry in the Preparatory Phase section of the Contractor Quality Control Report. Duplicate this information in the header of the second page of the report.
- c. Personnel Present: Indicate the number of hours of advance notice that was given to the Government Representative and indicate (Yes/No check boxes) whether or not the Government Rep was notified. Indicate the Names of Preparatory Phase Meeting attendees, their position and company/government they are with.
- d. Submittals: Indicate if submittals have been approved (Yes/No check boxes), if no indicate what has not been submitted. Are materials on hand (Yes/No check boxes) and if not, what items are missing. Check delivered material/equipment against approved submittals and comment as required.
- e. Material Storage: Indicate if materials/equipment is stored properly (Yes/No check boxes) and if not, what action is/was taken.

- f. Specifications: Review and comment on Specification Paragraphs that describe the material/equipment, procedure for accomplishing the work and clarify any differences.
- g. Preliminary Work & Permits: Ensure preliminary work is in accordance with the contract documents and necessary permits are on file, if not, describe the action taken.
- h. Testing: Identify who performs tests, the frequency, and where tests are to occur. Review the testing plan, report abnormalities, and if the test facilities have been approved.
- i. Safety: Indicate if the activity hazard analysis has been approved (Yes/No check boxes) and comment on the review of the applicable portions of the COE EM-385-1-1.
- j. Meeting Comments: Note comments and remarks during the Preparatory Phase Meeting that was not addressed in previous sections of this checklist.
- k. Other Items or Remarks: Note any other remarks or items that were a result of the Preparatory Phase.
- l. QC Manager will sign and date the checklist.

1.14.4 Initial Phase Checklist

Each Definable Feature of Work that is in the Initial Phase shall have this checklist filled out for it. The checklist shall be identified by terminology consistent with the construction schedule. Attach this checklist to the Contractor Quality Control Report of the same date.

- a. Specification Section, date of report, and Contract number shall be entered.
- b. Definable Feature of Work, Schedule Activity No. and Index # entry and format will match entry in the Initial Phase section of the Contractor Quality Control Report.
- c. Personnel Present: Indicate the number of hours of advance notice that was given to the Government Representative and indicate (Yes/No check boxes) whether or not the Government Rep was notified. Indicate the Names of Initial Phase Meeting attendees, their position and company/government they are with.
- d. Procedure Compliance: Comment on compliance with procedures identified at Preparatory Phase of Control and assurance that work is in accordance with plans, specifications and submittals.
- e. Preliminary Work: Ensure preliminary work being placed is in compliance and if not, what action is/was taken.
- f. Workmanship: Identify where initial work is located; if a sample panel is required (Yes/No check boxes); is the initial work the

sample (Yes/No check boxes); and if Yes, describe the panel location and precautions taken to preserve the sample.

- g. Resolution: Comment on any differences and the resolutions reached.
- h. Check Safety: Comment on the safety review of the job conditions.
- i. Other: Note any other remarks or items that were a result of the Initial Phase.
- j. QC Manager will sign and date the checklist.

1.14.5 Testing Plan and Log

As tests are performed, the QC Manager shall record on the "Testing Plan and Log" the date the test was conducted, the date the test results were forwarded to the Contracting Officer, remarks and acknowledgement that an accredited or Contracting Officer approved testing laboratory was used. Attach a copy of the updated "Testing Plan and Log" to the last daily Contractor Quality Control Report of each month.

1.14.6 Rework Items List

The QC Manager shall maintain a list of work that does not comply with the Contract, identifying what items need to be reworked, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. Attach a copy of the "Rework Items List" to the last daily Contractor Quality Control Report of each month. The Contractor shall be responsible for including on this list items needing rework including those identified by the Contracting Officer.

1.14.7 As-Built Drawings

The QC Manager is required to ensure the as-built drawings, required by Section 01770, "Closeout Procedures," are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g. PC No., Modification No., Request for Information No., etc.). The QC Manager shall initial each deviation and each revision. Upon completion of work, the QC Manager shall furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the Contracting Officer.

1.14.8 Report Forms

The following forms, are acceptable for providing the information required by the paragraph entitled "Documentation." While use of these specific formats are not required, any other format used shall contain the same information:

- a. Combined Contractor Production Report and Contractor Quality Control Report, with separate continuation sheet(s).

- b. Preparatory Phase Checklist.
- c. Initial Phase Checklist.
- d. Testing Plan and Log.
- e. Rework Items List.

1.15 NOTIFICATION ON NON-COMPLIANCE

The Contracting Officer will notify the Contractor of any detected non-compliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time for excess costs or damages by the Contractor.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C511 (1997) Reduced-Pressure Principle Backflow
Prevention Assembly

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH
(FCCCHR)

FCCCHR-CCC Manual of Cross-Connection Control

FCCCHR-USC List of Approved Backflow Prevention
Assemblies

FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA MUTCD (1988) Manual on Uniform Traffic Control
Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 241 (1996) Safeguarding Construction,
Alteration, and Demolition Operations

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal
Procedures."

SD-01 Preconstruction Submittals

Construction site plan; G

SD-03 Product Data

Backflow preventers

SD-06 Test Reports

Backflow Preventer Tests; G

SD-07 Certificates

Backflow Tester Certification; G

1.3 CONSTRUCTION SITE PLAN

Prior to the start of work, submit a site plan showing the locations of temporary facilities (including layouts and details, equipment and material storage area (on site and offsite), and access and haul routes used for this contract. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

1.4 BACKFLOW PREVENTERS CERTIFICATE

Certificate of Full Approval from FCCCHR-USC, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval will not be acceptable.

1.4.1 Backflow Prevention Training Certificate

The Contractor shall submit a certificate recognized by the State or local authority that states the Contractor has completed at least 10 hours of training in backflow preventer installations. The certificate must be current.

1.5 TEMPORARY UTILITIES

Reasonable amounts of the following utilities will be made available to the Contractor without charge.

- Electricity -
- Potable Water -
- Salt Water -
- Compressed Air -
- Steam -
- Sanitary Sewer -

The point at which the Government will deliver such utilities or services and the quantity available is as indicated. The Contractor shall pay all costs incurred in connecting, converting, and transferring the utilities to the work. The Contractor shall make connections, including providing backflow-preventing devices on connections to domestic water lines; providing meters; and providing transformers; and make disconnections.

1.5.1 Contractor Utilities

The Contractor shall provide his own utilities.

1.6 BACKFLOW TESTER CERTIFICATION

Prior to testing, submit to the Contracting Officer certification issued by the State or local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory agency. Tester shall not be affiliated with any company participating in any other phase of this Contract.

1.7 WEATHER PROTECTION

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

1.7.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions shall include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.

1.8 STATION OPERATION AFFECT ON CONTRACTOR OPERATIONS

1.8.1 Restricted Access Areas

The Government will monitor work in areas indicated. Notify Contracting Officer at least 14 calendar days prior to starting work in these areas.

1.9 STORAGE AREAS

Contractor shall be responsible for security of his property. The Contract Clause entitled "FAR 52.236-10, Operations and Storage Areas" and the following apply:

1.9.1 Storage Size and Location

The open site available for storage shall be confined to the indicated operations area .

1.10 TEMPORARY SANITARY FACILITIES

Provide adequate sanitary conveniences of a type approved for the use of persons employed on the work, properly secluded from public observation, and maintained in such a manner as required and approved by the Contracting Officer. Maintain these conveniences at all times without nuisance. Upon completion of the work, remove the conveniences from the premises, leaving the premises clean and free from nuisance. Dispose of sewage through connection to a municipal, district, or station sanitary sewage system. Where such systems are not available, use chemical toilets or comparably

effective units, and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Include provisions for pest control and elimination of odors.

1.11 TEMPORARY BUILDINGS

Temporary facilities(including trailers) shall be in like new condition. Locate these facilities where directed and within the indicated operations area. Storage of material/debris under such facilities is prohibited. Contractor shall be responsible for the security of the stored property.

1.11.1 Maintenance of Temporary Facilities

Suitably paint and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

1.11.2 Quality Control Manager Records and Field Office

Provide on the jobsite an office with approximately 200 square feet of useful floor area for the exclusive use of the QC Manager. Provide a weathertight structure with adequate heating and cooling, toilet facilities, lighting, ventilation, a 4 by 8 foot plan table, a standard size office desk and chair, computer station, and working communications facilities. Provide either a 1,500 watt radiant heater and a window-mounted air conditioner rated at 9,000 Btus minimum or a window-mounted heat pump of the same minimum heating and cooling ratings. Provide a door with a cylinder lock and windows with locking hardware. Make utility connections. Locate as directed . File quality control records in the office and make available at all times to the Government. After completion of the work, remove the entire structure from the site.

1.11.3 Trailers or Storage Buildings

Trailers or storage buildings will be permitted, where space is available, subject to the approval of the Contracting Officer. The trailers or buildings shall be in good condition, free from visible damage rust and deterioration, and meet all applicable safety requirements. Trailers shall be road worthy and comply with all appropriate state and local vehicle requirements. Failure to maintain storage trailers or buildings to these standards shall result in the removal of non-complying units at the Contractor's expense. A sign not smaller than 24 by 24 inches shall be conspicuously placed on the trailer depicting the company name, business phone number, and emergency phone number. Trailers shall be anchored to resist high winds and must meet applicable state of local standards for anchoring mobile trailers.

1.11.3.1 LANTNAVFACENGCOM Trailer Sign

A sign that conforms to the following requirements and sketch shall be mounted on the trailer or building that shows the company name, phone number, and emergency phone number.

Sign requirements:

Graphic panel: Aluminum, painted blue

Copy: Screen painted or vinyl die-cut, white

Typeface: Univers 65 u/lc

See Sketch No. 01500 (graphic).

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 TEMPORARY PHYSICAL CONTROLS

3.1.1 Access Controls

3.1.1.1 Temporary Barricades

Contractor shall provide for barricading around all work areas to prevent public access.

3.1.1.2 Fencing

Fencing shall be provided along the construction site at all open excavations and tunnels to control access by unauthorized people. Fencing must be installed to be able to restrain a force of at least 250 pounds against it.

3.1.1.3 Signs

Place warning signs at the construction area perimeter designating the presence of construction hazards requiring unauthorized persons to keep out. Signs must be placed on all sides of the project, with at least one sign every 300 feet. All points of entry shall have signs designating the construction site as a hard hat area.

3.1.1.4 Traffic Work

All work around/involving roadways, to include roadway excavations and utility crossings, will be conducted in accordance with Manual of Traffic Control Devices. Contractors shall provide and ensure appropriate road closure and detour signs are established as necessary for motor traffic management. All road closures shall be coordinated with the Contracting Officer in advance. Self-illuminated (lighted) barricades shall be provided during hours of darkness. Brightly-colored (orange) vests are required for all personnel working in roadways. Road closures shall require a road closure plan showing the location of signage.

3.2 TEMPORARY WIRING

Provide temporary wiring in accordance with NFPA 241 and NFPA 70, Article 305-6(b), Assured Equipment Grounding Conductor Program. Program shall

include frequent inspection of all equipment and apparatus.

3.3 REDUCED PRESSURE BACKFLOW PREVENTERS

Provide an approved reduced pressure backflow prevention assembly at each location where the Contractor taps into the Government potable water supply.

A certified tester(s) shall perform testing of backflow preventer(s) for proper installation and operation and provide subsequent tagging. Backflow preventer tests shall be performed using test equipment, procedures, and certification forms conforming to those outlined in the latest edition of the Manual of Cross-Connection Control published by the FCCCHR-CCC. Test and tag each reduced pressure backflow preventer upon initial installation (prior to continued water use) and quarterly thereafter. Tag shall contain the following information: make, model, serial number, dates of tests, results, maintenance performed, and signature of tester. Record test results on certification forms conforming to requirements cited earlier in this paragraph.

3.4 GRASS CUTTING

Cut grass (or annual weeds) within the construction and storage sites to a maximum 4 inch height at least once a week during the growing season unless the grass area is not visible to the public. Trim the grass around fences at time of grass cutting. Maintain grass or weeds on stockpiled earth as described above.

-- End of Section --

SECTION 01525

SAFETY REQUIREMENTS
03/00

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Related Sections

- a. Section 01310, "Administrative Requirements"
- b. Section 01500, "Temporary Facilities and Controls"
- c. Section 02315, "Excavation and Fill"

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|-------------|---|
| ANSI A10.14 | (1991) Construction and Demolition
Operations - Requirements for Safety
Belts, Harnesses, Lanyards and Lifelines
for Construction and Demolition Use |
| ANSI Z359.1 | (1992) Safety Requirements for Personal
Fall Arrest Systems |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- | | |
|-------------|---------------------------------|
| ASME B30.5 | (1994) Mobile Cranes |
| ASME B30.22 | (1993) Articulating Boom Cranes |

CODE OF FEDERAL REGULATIONS (CFR)

- | | |
|--------------------|--|
| 29 CFR 1910.94 | Ventilation |
| 29 CFR 1910.120 | Hazardous Waste Operations and Emergency
Response |
| 29 CFR 1926.65 | Hazardous Waste Operations and Emergency
Response |
| 29 CFR 1926.502(f) | Warning Line Systems |

CORPS OF ENGINEERS (COE)

COE EM-385-1-1 (1996) Safety and Health Requirements Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10 (1995) Portable Fire Extinguishers

NFPA 70 (1999) National Electrical Code

NFPA 241 (1996) Safeguarding Construction, Alteration, and Demolition Operations

1.3 DEFINITIONS

- a. Certified Industrial Hygienist. An industrial hygienist is an individual who is certified by the American Board of Industrial Hygiene.
- b. Certified Safety Professional. A safety manager, safety specialist, or safety engineer that has passed the CSP exam administered by the Board of Certified Safety Professionals.
- c. Competent Person. A competent person is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.
- d. Confined Space. A space which by design has limited openings for entry and exit, unfavorable natural ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy. Confined spaces include, but are not limited to storage tanks, process vessels, pits, silos, vats, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines.
- e. First Aid. First aid is any one-time treatment, and any follow-up visit for the purpose of observation, of minor scratches, cuts, burns, splinters, and so forth, which do not ordinarily require medical care, even though provided by a physician or registered professional personnel.
- f. Health and Safety Plan (HASP). The HASP is the Navy equivalent Army term of SHP or SSHP used in COE EM-385-1-1. "USACE" property and equipment specified in COE EM-385-1-1 should be interpreted as Government property and equipment.
- g. Lost Workdays. The number of days (consecutive or not) after, but not including, the day of injury or illness during which the employee would have worked but could not do so; that is, could not perform all or part of his normal assignment during all or any part of the workday or shift; because of the occupational injury or illness.

- h. Medical Treatment. Medical treatment includes treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.
- i. Multi-employer work site (MEWS). A multi-employer work site, as defined by OSHA, is one in which many employers occupy the same site. The Navy considers the prime contractor to be the "controlling authority" for all work site safety and health of the subcontractors.
- j. Operating Envelope. There is an "operating envelope" around any crane, and inside the envelope are the operator, riggers, rigging gear between the hook and the load, the load and the crane's supporting structure (ground, rail, etc.).
- k. Qualified Person. One who, by possession of a recognized degree, certificate, or professional standing, or extensive knowledge, training, and experience, has successfully demonstrated his or her ability to solve or resolve problems related to the subject matter, the work or the project.
- l. Recordable Occupational Injuries or Illnesses. Any occupational injuries or illnesses which result in:
 - (1) Fatalities, regardless of the time between the injury and death, or the length of the illness; or
 - (2) Lost Workday Cases, other than fatalities, that result in lost workdays, or
 - (3) Non-Fatal Cases without lost workdays which result in transfer to another job or termination of employment, or require medical treatment (other than first aid) or involve: loss of consciousness or restriction of work or motion. This category also includes any diagnosed occupational illnesses which are reported to the employer but are not classified as fatalities or lost workday cases.
- m. Safety Officer. The superintendent or other qualified or competent person who is responsible for the on-site safety required for the project. The contractor quality control person cannot be the safety officer, even through the QC has safety inspection responsibilities as part of the QC duties.
- n. Serious Accidents. Any work-related incident, which results in, a fatality, in-patient hospitalization of three or more employees, or property damage in excess of \$200,000.
- o. Significant Accident. Any contractor accident which involves falls of (4 feet) or more, electrical accidents, confined space accidents, diving accidents, equipment accidents, crane accident

or fire accidents, which, result in property damage of \$10,000 or more, but less than \$200,000; or when fire department or emergency medical treatment (EMT) assistance is required.

- p. Weight Handling Equipment (WHE) Accident. A WHE accident occurs when any one or more of the six elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; and collision, including unplanned contact between the load, crane, and/or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.).

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-07 Certificates

Accident Prevention Plan (APP); G

Activity Hazard Analysis (AHA); G

SD-11 Closeout Submittals

Daily Confined Space Entry Permit

Submit one copy of each permit attached to each Daily Production Report.

Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

a. Qualifications of Safety Officer:

(1) Ability to manage the on-site contractor safety program through appropriate management controls.

(2) Ability to identify hazards and have the capability to expend resources necessary to abate the hazards.

(3) Must have worked on similar types of projects that are equal to or exceed the scope of the project assigned with the same responsibilities.

(4) Shall, as a minimum, have attended an OSHA training qualification class including at least 10 hours of classroom instruction.

b. Qualifications of Qualified Person, Confined Space Entry. The qualified person shall be capable (by education and specialized training) of anticipating, recognizing, and evaluating employee exposure to hazardous substances or other unsafe conditions in a confined space. This person shall be capable of specifying necessary control and protective action to ensure worker safety.

c. Qualification of Crane Operators. Crane operators shall meet the requirements in COE EM-385-1-1, Appendix G.

1.5.2 Meetings

1.5.2.1 Preconstruction Conference

The safety officer shall attend the preconstruction conference.

1.5.2.2 Work Phase Meetings

The appropriate AHA shall be reviewed and attendance documented by the Contractor at the preparatory, initial, and follow-up phases of quality control inspection.

1.5.2.3 New Employee Indoctrination

New employees will be informed of specific site hazards before they begin work. Documentation of this orientation shall be kept on file at the project site.

1.5.3 Certifications

1.5.3.1 Accident Prevention Plan (APP)

Submit the APP at least 15 calendar days prior to start of work at the job site, following Appendix A of COE EM-385-1-1. Make the APP site specific. Notice To Proceed will be given after Government finds the APP acceptable.

1.5.3.2 Activity Hazard Analysis (AHA)

Submit the AHA for review at least 15 calendar days prior to the start of each phase. Format subsequent AHA as amendments to the APP. In accordance with contract quality control requirements each AHA will be reviewed during an on-site preparatory inspection.

1.6 ACCIDENT PREVENTION PLAN (APP)

Prepare the APP in accordance with the required and advisory provisions of

COE EM-385-1-1 including Appendix A, "Minimum Basic Outline for Preparation of Accident Prevention Plan," and as modified herein. Include the associated AHA and other specific plans, programs and procedures listed on Pages A-3 and A-4 of COE EM-385-1-1, some of which are listed below.

1.6.1 Contents of the Accident Prevention Plan

- a. Name and safety related qualifications of safety officer (including training and any certifications).
- b. Qualifications of competent and of qualified persons.
- c. Identity of the individual who will complete exposure data (hours worked); accident investigations, reports and logs; and immediate notification of accidents to include subcontractors.
- d. Emergency response plan. Conform to COE EM-385-1-1, paragraph 01.E and include a map denoting the route to the nearest emergency care facility with emergency phone numbers. Contractor may be required to demonstrate emergency response.
- e. Confined Space Entry Plan. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)
- f. Hazardous Material Use. Provisions to deal with hazardous materials, pursuant to the Contract Clause "FAR 52.223-3, Hazardous Material Identification and Material Safety Data." And the following:
 - (1) Inventory of hazardous materials to be introduced to the site with estimated quantities.
 - (2) Plan for protecting personnel and property during the transport, storage and use of the materials.
 - (3) Emergency procedures for spill response and disposal, including a site map with approximate quantities on site at any given time. The site map will be attached to the inventory, showing where the hazardous substances are stored.
 - (4) Material Safety Data Sheets for inventoried materials not required in other section of this specification.
 - (5) Labeling system to identify contents on all containers on-site.
 - (6) Plan for communicating high health hazards to employees and adjacent occupants.

- g. Hazardous Energy Control Plan. For hazardous energy sources, comply with COE EM-385-1-1, paragraph 12.A.07.
- h. Alcohol and Drug Abuse Plan
 - (1) Describe plan for random checks and testing with pre-employment screening in accordance with the DFAR Clause subpart 252.223-7004, "Drug Free Work Force."
 - (2) Description of the on-site prevention program
- i. Fall Protection and Prevention (FP&P) Plan. The plan shall be site specific and address all fall hazards in the work place. It shall address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet. A qualified person shall prepare the plan. The plan shall include fall protection and prevention systems, equipment and methods employed, responsibilities, rescue and escape equipment and operations, training requirements, and monitoring methods. FP&P Plan shall be revised once every six months for lengthy projects, to reflect any new changes during the course of construction, due to changes of personnel, equipment, systems or work habits.
- j. Silica Exposure Reduction. The plan shall include specific procedures to prevent employee silica inhalation exposures.
- k. Training Records and Requirements. List of mandatory training and certifications which are applicable to this project (e.g. explosive actuated tools, confined space entry, fall protection, crane operation, vehicle operator, forklift operators, personal protective equipment); list of requirements for periodic retraining/certification; outline requirements for supervisory and employee safety meetings.
- l. Severe Weather Plan. Procedures of ceasing on-site operations during lightning or upon reaching maximum allowed wind velocities.
- m. Emergency Lighting and Power Systems Plan (e.g. periodic testing of batteries for emergency lighting.)

1.7 ACTIVITY HAZARD ANALYSIS (AHA)

Prepare for each phase of the work. As a minimum, define activity being performed, sequence of work, specific hazards anticipated, control measures to eliminate or reduce each hazard to acceptable levels, training requirements for all involved, and the competent person in charge of that phase of work. For work with fall hazards, including fall hazards associated with scaffold erection and removal, identify the appropriate fall arrest systems. For work with materials handling equipment, address safeguarding measures related to materials handling equipment. For work requiring excavations, include excavation safeguarding requirements. The appropriate AHA shall be reviewed and attendance documented by the Contractor at the preparatory, initial, and follow-up phases of quality

control inspection.

1.8 DRUG PREVENTION PROGRAM

Conduct a proactive drug and alcohol use prevention program for all workers, prime and subcontractor, on the site. Ensure that no employees either use illegal drugs or consume alcohol during work hours. Ensure there are no employees under the influence of drugs or alcohol during work hours. After accidents, collect blood, urine or saliva specimens and test injured employee's influence. A copy of the test shall be made available to the Contracting Officer upon request.

1.9 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

1.9.1 Scaffolds

Delineate the fall protection requirements necessary during the erection and dismantling operation of scaffolds used on the project in the Fall Protection and Prevention (FP&P) plan and activity hazard analysis for the phase of work.

1.10 DUTIES OF THE SAFETY OFFICER

- a. Ensure construction hazards are identified and corrected.
- b. Maintain applicable safety reference material on the job site.
- c. Maintain a log of safety inspections performed.
- d. Attend the pre-construction conference as required.
- e. Identify hazardous conditions and take corrective action. Failure to do so will result in a dismissal from the site, with a work stoppage pending approval of suitable replacement personnel.

1.11 DISPLAY OF SAFETY INFORMATION

Display the following information in clear view of the on-site construction personnel:

- a. Map denoting the route to the nearest emergency care facility with emergency phone numbers.
- b. AHA
- c. Confined space entry permit.

1.12 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturers' manuals.

1.13 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment. However, if emergency medical care is rendered by Navy medical services, charges may be billed to Contractor at prevailing rates established in BUMED Instruction 6320.4 series. Reimbursement shall be made by Contractor to Naval Regional Medical Center Collection Agent upon receipt of monthly statement.

1.14 SITE CONDITIONS

1.14.1 Noise

The adjacent Government activities produce sound-pressure levels. Enforce hearing protection protecting contractor's site personnel from Government produced noise during times of aircraft operation.

1.15 REPORTS

1.15.1 Accident Reports

- a. For recordable occupational injuries and illnesses, the Prime Contractor shall conduct an accident investigation to establish the root cause(s) of the accident, complete the Navy Contractor Significant Incident Report (CSIR) form and provide to the Contracting Officer within 5 calendar days of the accident. The Contracting Officer will provide a copy of the CSIR form.
- b. For a weight handling equipment accident the Prime Contractor shall conduct an accident investigation to establish the root cause(s) of the accident, complete the WHE Accident Report form and provide to the Contracting Officer within 30 calendar days of the accident. The Contracting Officer will provide a copy of the WHE accident report form.

1.15.2 Notification

Notify the Contracting Officer as soon as practical, but not later than four hours, of any accident meeting the definition of Recordable Occupational Injuries or Illnesses or Significant Accidents. Information shall include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; and brief description of accident (to include type of construction equipment used, PPE used, etc.).

1.15.3 Monthly Exposure Report

Monthly exposure reporting, to the Contracting Officer is required to be attached to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor.

1.15.4 OSHA Citations and Violations

Provide the Contracting Officer with a copy of each OSHA citation, OSHA report and contractor response. Correct violations and citations promptly and provide written corrective actions to the Contracting Officer.

1.15.5 Crane Notification

Notify Contracting Officer at least 15 days prior to bringing any crane equipment on-site so that the contracting officer may arrange for any additional quality assurance spot checks necessary by the government.

1.16 HOT WORK

Prior to performing "Hot Work" (welding, etc.) or operating other flame-producing devices, the Contractor shall request a written permit from the Fire Division. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Contractor will provide at least two (@2) twenty (20) pound extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity.

- a. Oil painting materials (paint, brushes, empty paint cans, etc.), and all flammable liquids shall be removed from the building at quitting time. All painting materials and flammable liquids shall be stored outside in a suitable metal locker or box and will require re-submittal with non-hazardous materials.
- b. Accumulation of trays, paper, shavings, sawdust, boxes and other packing materials shall be removed from the building at the close of each workday and such material disposed of in the proper containers located away from the building.
- c. The storage of combustible supplies shall be a safe distance from structures.
- d. Area outside of building undergoing work shall be cleaned of trash, paper, or other discarded combustibles at the close of each workday.
- e. All portable electric devices (saws, sanders, compressors, extension chord, lights, etc.) shall be disconnected at the close of each workday. When possible, the main electric switch in the building shall be deactivated.
- f. When starting work in building or areas, Contractors shall require their personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency Fire Division phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE ROICC/BASE FIRE DIVISION IMMEDIATELY.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 CONSTRUCTION

Comply with COE EM-385-1-1, NFPA 241, the accident prevention plan, the activity hazard analysis and other related submittals and activity fire and safety regulations.

3.1.1 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint are prohibited. Exceptions to the use of any of the above excluded materials may be considered by Contracting Officer upon written request by Contractor.

3.1.2 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and nonfriable asbestos. If material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages a minimum of 15 days in advance. As a minimum, the request should include the location of the outage, utilities being effected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved and prior to beginning work on the utility system requiring shut down, the Contractor shall attend a pre-outage coordination meeting with the ROICC and the Station Utilities Department to review the scope of work and the lock out/tag out procedures for worker protection. No work will be performed on energized electrical equipment unless proven impassable. Working equipment "hot" must be considered the last option.

3.3 PERSONNEL PROTECTION

3.3.1 Hazardous Noise

Provide hazardous noise signs, and hearing protection, wherever equipment and work procedures produce sound-pressure levels greater than 85 dBA steady state or 140 dBA impulse, regardless of the duration of the exposure.

3.3.2 Fall Protection

Enforce use of the fall protection device designated for each specific work activity in the FP&P plan and/or AHA all times when an employee is on a surface 6 feet or more above lower levels. Personal fall arrest systems are required when working from an articulating or extendible boom, scissor lifts, swing stages, or suspended platform. Fall protection must comply with ANSI A10.14.

3.3.2.1 Personal Fall Arrest Device

Personal fall arrest device equipment, systems, subsystems, and components shall meet ANSI Z359.1, "Safety Requirements for Personal Fall Arrest Systems". Only a full-body harness with a shock absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest device. Body belts may only be used as a positioning device system such as steel reinforcing assembly and in conjunction with another fall arrest system. Harnesses shall have a fall arrest attachment, which is a connector, affixed to the body support (usually a D-ring) and specifically designated for attachment to the rest of the system. Only double locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber.

3.3.2.2 Fall Protection for Roofing Work

Fall protection controls shall be implemented based on the type of roof being constructed and work being performed. The roof area to be accessed shall be evaluated for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within 6 feet of an edge, on low-slope roofs, personnel shall be protected from falling by use of personal fall arrest systems, guardrails, or safety nets. Safety monitoring system is not adequate fall protection and is not authorized.

(2) For work greater than 6 feet from an edge, warning lines shall be erected and installed in accordance with 29 CFR 1926.502(f).

b. Steep Roofs: Work on steep roofs requires personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

3.3.2.3 Safety Nets

If safety nets are used as the selected fall protection system on the project, they shall be provided at unguarded workplaces, over water, machinery, dangerous operations and leading edge work.

3.3.2.4 Existing Anchorage

Existing anchorages, used for attachment of personal fall arrest equipment,

if to be used by the Contractor, shall be re-certified by the contractor's fall protection engineer (QP).

3.4 SCAFFOLDING

Employees shall be provided with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Stair towers or ladders built into scaffold systems in accordance with USACE EM 385-1-1 Appendix J are required for work platforms greater than 20 feet in height. Contractor shall ensure that employees that are qualified perform scaffold erection. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection plan. Minimum platform size shall be based on the platform not being greater in height than three times the dimension of the smallest width dimension for rolling scaffold. Some Baker type scaffolding has been found not to meet these requirements. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward. Special care shall be given to ensure scaffold systems are not overloaded. Outrigger brackets used to extend scaffold platforms on self supported scaffold systems for the storage of material is prohibited. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base.

3.5 EQUIPMENT

3.5.1 Material Handling Equipment

- a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.
- b. The use of hooks on equipment for lifting of material must be in accordance with manufacturers printed instructions.

3.5.2 Weight Handling Equipment

- a. Cranes must be equipped with:
 - (1) Load Indicating Devices (LIDs) and a Boom Angle or Radius Indicator,
 - (2) or Load-Moment Indicating Devices (LMIs).
 - (3) Anti-two-block prevention devices.
 - (4) Boom Hoist Hydraulic Relief Valve, Disconnect, or Shutoff (stops hoist when boom reaches a predetermined high angle).
 - (5) Boom Length Indicator (for telescoping booms).
 - (6) Device to prevent uncontrolled lowering of a telescoping hydraulic boom.

- (7) Device to prevent uncontrolled retraction of a telescoping hydraulic boom.
- b. The Contractor shall notify the Contracting Officer, in advance, of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated.
 - c. The Contractor shall comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Erection shall be performed under the supervision of a designated person (as defined in ASME B30.5). All testing shall be performed in accordance with the manufacturers recommended procedures.
 - d. The Contractor shall comply with ASME B30.5 for mobile cranes, and ASME B30.22 for articulating boom cranes.
 - e. The presence of Naval station safety and health inspectors does not relieve the Contractor of an obligation to comply with all applicable safety regulations. The Government will investigate all complaints of unsafe or unhealthful working conditions received in writing from contractor employees, federal civilian employees, or military personnel.
 - f. Each load shall be rigged/attached independently to the hook/master-link in such a fashion that the load cannot slide or otherwise become detached. Christmas-tree lifting (multiple rigged materials) is not allowed.
 - g. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and shall follow the requirements of ASME B30.5 or ASME B30.22 as applicable.
 - h. Crane supported work platforms shall only be used in extreme conditions if the Contractor proves that using any other access to the work location would provide a greater hazard to the workers. Personnel shall not be lifted with a live hoist or friction crane.
 - i. A fire extinguisher having a minimum rating of 10BC and a minimum nominal capacity of 5lb of extinguishing agent shall be available at all operator stations or cabs of cranes. Portable fire extinguishers shall be inspected, maintained, and recharged as specified in NFPA 10, Standard for Portable Fire Extinguishers.
 - j. All employees shall be kept clear of loads about to be lifted and of suspended loads.
 - k. A weight handling equipment operator shall not leave his position at the controls while a load is suspended.
 - l. A Contractor Crane Operation Checklist shall be used by the CQC representative during oversight of contractor crane operations

(refer to COE EM-385-1-1 Appendix H and ROICC for copies).

- m. Only contractor crane operators who have met the requirements of 29 CFR 1910.94, 29 CFR 1910.120, 29 CFR 1926.65, 29 CFR 1926.502(f), COE EM-385-1-1, ASME B30.5, and ASME B30.22 and other local and state requirements shall be authorized to operate the crane.
- n. Cribbing shall be utilized by the Contractor when performing lifts on outriggers.
- o. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.
- p. A physical barricade must be positioned to prevent personnel from entering the tailswing area of the crane.
- q. A substantial and durable rating chart containing legible letters and figures shall be provided with each crane and securely mounted onto the crane cab in a location allowing easy reading by the operator while seated in the control station.
- r. Certification records which include the date of inspection, signature of the person performing the inspection along with the serial number or other identifier of the crane which was inspected. This record will always be available for review by contracting officer personnel.
- s. Written reports listing the load test procedures utilized along with any repairs or alterations performed on the crane will be available for review by the contracting officer personnel.
- t. Contractor shall certify that all of the crane operators have been trained not to bypass safety devices (e.g. anti-two block devices) during lifting operations.

3.6 Excavations

The competent person for excavation performed as a result of contract work shall be on-site when work is being performed in excavation, and shall inspect excavations prior to entry by workers. The competent person must evaluate for all hazards, including atmospheric, that may be associated with the work, and shall have the resources necessary to correct hazards promptly. Prior to digging the appropriate digging permit must be obtained. All underground utilities in the work area must be positively identified by a utility locating service and coordinated with Station Utility Departments. The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. If construction is parallel to an existing utility the utility shall be exposed by hand digging every 30 m (100 feet) if parallel within 5 feet of the excavation. Trench and shoring systems must be identified in the accepted safety plan and activity hazard analysis. Extreme care must be used when excavating near direct burial electric underground cables. Trenching machines with digging chain drives

shall be operated only when the spotters/laborers are in plain view of the operator. Operator and spotters/laborers shall be provided training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Documentation of the training shall be kept on file in the project site office or trailer.

3.7 ELECTRICAL

3.7.1 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cable intended to be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the Contracting Officer and Station Utilities for identification. The Contracting Officer will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cutting remotely. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers shall be permitted to enter. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. Insulating blankets, hearing protection, and switching suits may be required, depending on the specific job and as delineated in the Contractor AHA.

3.7.2 Portable Extension Cords

Portable extension cords shall be sized in accordance with manufacturer ratings for the tool to be powered.

3.8 WORK IN CONFINED SPACES

Comply with the requirements in Section 06.I of COE EM-385-1-1. Any potential for a hazard in the confined space requires a permit system to be used.

- a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 06.I.05 of COE EM-385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.
- b. Forced air ventilation is required for all confined space entry

operations and the minimum air exchange requirements must be maintained.

- c. Ensure the use of rescue and retrieval devices in confined spaces greater than 5 feet in depth. Conform to Sections 06.I.09, 06.I.10 and 06.I.11 of COE EM-385-1-1.
- d. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.
- e. Include training information for employees who will be involved as entrant attendants for the work. Conform to Section 06.I.06 of COE EM-385-1-1.
- f. Entry Permit. Use ENGFORM 5044-R or other form with the same minimum information for the Daily Confined Space Entry Permit, completed by the qualified person. Post the permit in a conspicuous place close to the confined space entrance.

3.9 CRYSTALLINE SILICA

Grinding, abrasive blasting, and foundry operations of construction materials containing crystalline silica, shall comply with OSHA regulations, such as 29 CFR 1910.94, and COE EM-385-1-1, (Appendix C). The Contractor shall develop and implement effective exposure control and elimination procedures to include dust control systems, engineering controls, and establishment of work area boundaries, as well as medical surveillance, training, air monitoring, and personal protective equipment.

3.10 HOUSEKEEPING

3.10.1 Clean-up

All debris in work areas shall be cleaned up daily or more frequently as necessary. Construction debris may be temporarily located in an approved location, however garbage accumulation must be removed each day.

3.10.2 Dust Control

In addition to the dust control measures required elsewhere in the contract documents dry cutting of brick or masonry shall be prohibited. Wet cutting must address control of water run off.

3.11 ACCIDENT SCENE PRESERVATION

For serious accidents, and accidents involving weight handling equipment, ensure the accident site is secured and evidence is protected remaining undisturbed until released by the Contracting Officer.

3.12 FIELD QUALITY CONTROL

3.12.1 Inspections

Include safety inspection as a part of the daily Quality Control

inspections required in Section 01450, "Quality Control".

3.13 FLAMMABLE AND COMBUSTIBLE LIQUID HANDLING AND STORAGE

3.13.1 Safety Gas Containers

Handling of flammable and combustible liquids shall be in safety containers with flame arresters, with not more than 5 gallons capacity, having a spring-closing lid and spout cover and designed to safely relieve internal pressures under fire exposures. Flammable and combustible Liquids shall be stored in separate NFPA approved storage cabinets 50 feet away from any sources of ignition with suitable NO SMOKING OR OPEN FLAME signs posted in all such areas.

-- End of Section --

SECTION 01561
EROSION AND SEDIMENT CONTROL
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM C 33	(1997) Concrete Aggregates
ASTM D 3787	(1989) Bursting Strength of Knitted Goods - Constant-Rate-of-Transverse (CRT) Ball Burst Test
ASTM D 4355	(1992) Deterioration of Geotextiles From Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1996) Grab Breaking Load and Elongation of Geotextiles
ASTM D 5141	(1996) Determining Filtering Efficiency and Flow Rate of a Geotextile for Silt Fence Application Using Site-Specific Soil

MARYLAND DEPARTMENT OF THE ENVIRONMENT (MDE)

MDE ESCG	(1990) Erosion and Sediment Control Guidelines for State and Federal Projects
MDE SESC	(1994) Maryland Standards and Specifications for Soil Erosion and Sediment Control

NORTH CAROLINA SEDIMENT CONTROL COMMISSION (NCSCC)

NCSCC ESCM	(1993) Erosion and Sediment Control Planning and Design Manual
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VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS (1994) Road and Bridge Specifications

VIRGINIA SOIL AND WATER CONSERVATION COMMISSION (VSWCC)

VSWCC VESCH (1992) Virginia Erosion and Sediment
Control Handbook

1.2 DESCRIPTION OF WORK

The work includes the provision of temporary and permanent erosion control measures to prevent the pollution of air, water, and land within the project limits and in areas outside the project limits where work is accomplished in conjunction with the project.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures:"

SD-01 Preconstruction Submittals

Construction Sequence Schedule; G

SD-03 Product Data

Sediment Fence

Dust Suppressors

Filter Cloth Underliner

1.4 CONSTRUCTION SEQUENCE SCHEDULE

Submit a Contractor furnished construction work sequence schedule, a minimum of 30 days prior to start of construction. The work schedule shall coordinate the timing of land disturbing activities with the provision of erosion control measures to reduce on site erosion and off site sedimentation. Installation of temporary erosion control features shall be coordinated with the construction of permanent erosion control features to assure effective and continuous control of erosion and pollution.

1.5 EROSION CONTROL PLAN FOR VIRGINIA

The erosion control plan indicated has been approved. No additional review and approval is required, unless the Contractor desires to modify the erosion control plan indicated. All modifications shall be submitted to, and approved by, the Resident Officer in Charge of Construction prior to

start of construction. The Contractor shall be responsible for any additional costs and time incurred as a result of the modifications to the approved erosion control plan. Provide and maintain erosion control measures in accordance with VSWCC VESCH, and as specified herein.

PART 2 PRODUCTS

2.1 SEDIMENT FENCE

2.1.1 State Standard Sediment Fence

VSWCC VESCH Standard 3.05, silt fence (maximum height of 34 inches.

2.2 CONSTRUCTION ENTRANCE

2.2.1 State Standard Construction Entrance

2.2.1.1 Aggregate

VSWCC VESCH Standard 3.02.

2.2.1.2 Filter Cloth Underliner

A woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from ultraviolet, and with the following properties:

- a. Minimum grab tensile strength (TF 25 #1/ASTM D 4632) 180 pounds
- b. Minimum Puncture (TF 25 #4/ASTM D 3787) 75 psi in the weakest direction
- c. Apparent Opening Size 40-80 (U.S. Sieve Size)
- d. Minimum Trapezoidal tear strength (TF 25 #2/ASTM D 4533) 50 pounds

2.3 DUST SUPPRESSORS

Calcium chloride, or other standard manufacturer's spray on adhesives designed for dust suppression.

2.4 TEMPORARY SEEDING

2.4.1 State Standard Temporary Seeding

Provide seed, lime, and fertilizer in accordance with VSWCC VESCH Standard 3.31. Provide hay or straw mulch.

PART 3 EXECUTION

3.1 CONSTRUCTION SEQUENCE SCHEDULE

Stabilize areas for construction access immediately with gravel. Install principal sediment basins and traps before any major site grading takes

place. Provide additional sediment traps, sediment fences, and filter barriers as grading progresses. Stabilize graded and disturbed areas immediately after grading. Permanent stabilization shall be provided immediately on areas that have been final graded. Temporary seeding and mulching shall be provided on disturbed areas as specified in the paragraph entitled "Temporary Seeding." Installation of temporary erosion control features shall be coordinated with the construction of permanent erosion control features to assure effective and continuous control of erosion and sediment deposition. Remove temporary erosion control measures at the end of construction and provide permanent seeding.

3.2 SEDIMENT FENCES

Install posts at the spacing indicated and at an angle between 2 degrees and 20 degrees towards the potential silt load area. Sediment fence height shall be approximately 16 inches. Do not attach filter fabric to existing trees. Secure filter fabric to the post and wire fabric using staples, tie wire, or hog rings. Imbed the filter fabric into the ground as indicated. Splice filter fabric at support pole using a 6 inch overlap and securely seal.

3.3 CONSTRUCTION ENTRANCE

Provide as indicated, a minimum of 6 inches thick, at points of vehicular ingress and egress on the construction site. Construction entrances shall be cleared and grubbed, and then excavated a minimum of 3 inches prior to placement of the filter fabric and aggregate. The aggregate shall be placed in a manner that will prevent damage and movement of the fabric. Place fabric in one piece, where possible. Overlap fabric joints a minimum of 12 inches.

3.4 DUST SUPPRESSORS

Immediately dampen the surface before calcium chloride application. Apply dust suppressors on unsurfaced base, subbase and other unsurfaced travel ways. Apply calcium chloride at the rate of 1.0 to 1.25 pounds per square yard of surface for pellets for the initial application. For subsequent applications of calcium chloride, application rates may be approximately 75 percent of initial application rates. Do not apply when raining or the moisture conditions exceed that required for proper application. Apply other dust suppressors in accordance with manufacturers instructions. Protect treated surfaces from traffic for a minimum of 2 hours after treatment. Repeat application of dust suppressors as required to control dust emissions.

3.5 TEMPORARY SEEDING

3.5.1 Time Restrictions

Within 48 hours after attaining the grading increment specified herein, provide seed, fertilizer, mulch and water on graded areas when any of the following conditions occur:

- a. Grading operations stop for an anticipated duration of 30 days or

more.

- b. When it is impossible or impractical to bring an area to finish grade so that permanent seeding operations can be performed without serious disturbance from additional grading.
- c. When an immediate cover is required to minimize erosion, or when erosion has occurred.
- d. Provide on erosion control devices constructed using soil materials.

3.5.2 Seeding Requirements

3.5.2.1 State Standard Seeding Requirements

Provide seed, lime, and fertilizer in accordance with VSWCC VESCH Standard 3.31. Provide hay or straw mulch in an air dried condition, and secure mulch in place.

3.6 MAINTENANCE AND INSPECTION

Inspect erosion control devices after each rainfall and daily during prolonged rainfall. Remove sediment deposits after each rainfall or when sediment reaches approximately one-half the barrier height. Immediately repair damaged erosion control devices and damaged areas around and underneath the devices. Maintain erosion control devices to assure continued performance of their intended function. Modify the erosion control plan as required to control problem areas noticed after each inspection. Modifications shall be approved by the Contracting Officer.

3.7 CLEAN UP

At the completion of the job, or when directed or approved by the Contracting Officer, temporary erosion control devices shall be removed. Erosion control devices and areas immediately adjacent to the device shall be filled (where applicable), shaped to drain and to blend into the surrounding contours, and provided with permanent seeding. Erosion control devices may remain in place after job completion when approved by the Contracting Officer.

-- End of Section --

SECTION 01572

WASTE MANAGEMENT
09/99

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Construction and Demolition Waste

Solid wastes such as building materials, packaging and rubble resulting from construction, remodeling, demolition and repair of buildings/facilities, paving and infrastructure.

1.1.2 Recyclable Materials

Products and materials that can be recovered and remanufactured into a new product. Recyclable materials include, but are not limited to, the following:

- a. Metals (ferrous and non-ferrous), including banding, metal studs, ductwork, piping
- b. Asphaltic concrete paving
- c. Portland cement concrete
- d. Land clearing debris including trees and plant materials
- e. Native rock and granular fill
- f. Gypsum products
- g. Paper and cardboard
- h. Wood products, including structural, finish, crates and pallets
- i. Brick and masonry
- j. Carpet and padding
- k. Plastics
- l. Copper wiring
- m. Mechanical and electrical products and equipment

1.1.3 Recycling Facility

A business that specializes in collecting, handling, processing, distributing, or remanufacturing waste materials generated by demolition and new construction projects, into products or materials that can be used

for this project or by others.

1.1.4 Salvage and Reuse

Existing usable product or material that can be saved and reused in some manner on the project site. Materials that can be salvaged and reused must comply with the applicable technical specifications and include, but are not limited to, the following:

- a. Dimensional lumber and other wood products
- b. Structural steel
- c. Soil
- d. Masonry products

1.1.5 Salvage for Resale

Existing usable product or material that can be saved and removed intact (as is) from the project site to another site for resale to others without remanufacturing.

1.1.6 Trash

Product or material unable to be salvaged for resale, salvaged and reused, returned, or recycled.

1.1.7 Waste Materials

Product or material that can be salvaged for resale, salvaged and reused, returned to vendors, or recycled.

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

Waste Management Plan; G

1.3 CONSTRUCTION WASTE MANAGEMENT

1.3.1 General Intent

The Contractor shall use all means available to divert to the greatest extent practical and economically feasible, construction and demolition waste from landfills and incinerators.

1.3.2 Construction Waste Management Operations

Take a pro-active, responsible role in management of construction waste and require all subcontractors, vendors, and suppliers to participate in the

effort. Establish a construction waste management program that includes the following categories:

- a. Minimizing Packaging Waste
- b. Salvage and reuse
- c. Salvage for resale or donation
- d. Recycling
- e. Disposal

Salvage and reuse is a better waste management method than recycling because little or no reprocessing is necessary, thus less pollution is created when items are reused in their original form. Therefore, a diligent effort shall be made to salvage and reuse products and materials. Waste materials that cannot be salvaged and reused, and have value as being recyclable, shall be recycled. Only trash shall be transported to a landfill or incinerator. The Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling construction waste for this project. Revenues or other savings obtained for recycling or returns shall accrue to the Contractor.

1.3.3 Construction Waste Management Plan

Perform a waste analysis to determine the types and quantity of construction waste anticipated and identify salvage for resale, salvage and reuse, recycling and disposal options available. Within 30 days after contract award and prior to performing any demolition work, submit a Waste Management Plan for review and approval. The Waste Management Plan shall include the following:

- a. Project waste analysis.
- b. Projected cost of disposing of all trash and waste materials as if there would be no salvage or recycling on this project.
- c. Name, address and phone number for each landfill or incinerator facility to be utilized.
- d. Tipping fee for each landfill or incinerator.
- e. A list of waste materials that will be salvaged for resale, salvaged and reused, and recycled.
- f. Identification of each recycling facility to be utilized.
- g. Anticipated net cost savings determined by subtracting the cost of separating and recycling from the following:
 - 1. Savings due to reuse of demolished materials.

2. Revenue from the sale of salvaged and recycled materials.
3. Landfill or incinerator tipping fees saved due to diversion of materials to recycling.
- h. Description of the method to be employed in recycling waste materials and description of the method that will be used to protect recycled materials from contamination.
- i. Description of the means of transportation of recyclable materials and the destination of the materials.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PROGRAM IMPLEMENTATION AND MONITORING

Implement and maintain, for the duration of the project, the construction waste management program. Establish a method of monitoring and documenting the program, and submit a periodic report with each application for payment that includes the following:

- a. Amount (by weight) and type of waste materials disposed of in a landfill or incinerator, the tip fee per ton, and the total cost of disposal including transportation costs, container rental costs, etc.
- b. Amount (by weight) and type of materials salvaged for sale, salvaged for reuse, and recycled. Provide destination, means of transportation, cost of transportation and handling, tipping fee savings and revenue generated for each material.
- c. Cost savings due to salvaging, reusing, and recycling materials.

3.1.1 Hazardous Materials/Hazardous Wastes

If any non-acceptable materials such as hazardous materials or hazardous wastes are encountered, notify the Contracting Officer.

3.2 SALVAGE AND REUSE

Encourage the practice of efficient waste management when, sizing, cutting, and installing products and materials.

3.3 SEPARATION OF RECYCLABLE WASTE MATERIALS

Provide the necessary containers and bins, to facilitate the waste management program, that are clearly and appropriately marked. Prevent contamination of recyclable materials from incompatible products and materials. Separate construction waste at the project site by one of the following methods:

- a. Source Separated Method: Waste products and materials, that are recyclable, are separated from trash and sorted into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Trash is transported to a landfill or incinerator.
- b. Co-Mingled Method: All construction waste is placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed and the remaining trash is transported to a landfill or incinerator.
- c. Other methods proposed by the Contractor and approved by the Contracting Officer.

-- End of Section --

SECTION 01575

TEMPORARY ENVIRONMENTAL CONTROLS
03/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.1200	Hazard Communication
40 CFR 112	Oil Pollution Prevention
40 CFR 122.26	EPA National Pollutant Discharge Elimination System Permit Regulations
40 CFR 173	Title
40 CFR 241	Guidelines for Disposal of Solid Waste
40 CFR 243	Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste
40 CFR 258	Subtitle D Landfill Requirements
40 CFR 260	Hazardous Waste Management Systems: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standard for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste

	Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administrated Permit Programs: The Hazardous Waste Permit Program
40 CFR 271	Requirements for Authorization of State Hazardous Waste Programs
40 CFR 272	Approved State Hazardous Waste Management Programs
40 CFR 273	Universal Waste Management
40 CFR 279	Used Oil Regulations
40 CFR 280	Owners and Operators of Underground Storage Tanks
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 355	Emergency Planning and Notification
40 CFR 372-SUBPART D	EPA Toxic Chemical Release Reporting Regulations
40 CFR 716	Health and Safety Data Reporting
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 173	Shipments and Packagings
49 CFR 178	Packagings

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846	(1996) Evaluating Solid Waste (Physical/Chemical Methods)
EPA 832-R-92-005	Storm Water Management for Construction Activities

1.2 DEFINITIONS

1.2.1 Sediment

Soil and other debris that have eroded and have been transported by runoff water or wind.

1.2.2 Solid Waste

Garbage, refuse, debris, sludge, or other discharged material (except hazardous waste as defined in paragraph entitled "Hazardous Waste" or hazardous debris as defined in paragraph entitled "Hazardous Debris"), including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations. Material not regulated as solid waste are: nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

- a. Green waste: The vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be re-used are not included.
- b. Surplus soil: Existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included.
- c. Inert construction and demolition debris: Broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. Inert materials may not be re-enforced with or contain ferrous wire, rods, accessories and weldments.
- d. Wood: Dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated and/or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included.
- e. Scrap metal: Scrap and excess ferrous and non-ferrous metals such as re-in forcing steel, structural shapes, pipe and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.
- f. Paint cans: Metal cans that are empty of paints, solvents, thinners and adhesives. If permitted by the paint can label, a thin dry film may remain in the can.
- g. Recyclables: Materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable. Metal meeting the definition of lead contaminated or lead based paint contaminated may not be included as recyclable if sold to a scrap metal company. Paint cans may not be included as recyclable if sold to a scrap metal company.

1.2.3 Debris

Non-hazardous solid material generated during the construction, demolition, or renovation of a structure which exceeds 2.5 inch particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g. cobbles and boulders). A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

1.2.4 Hazardous Debris

As defined in paragraph entitled "Debris" of this section, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) per 40 CFR 261; or debris that exhibits a characteristic of hazardous waste per 40 CFR 261.

1.2.5 Chemical Wastes

This includes salts, acids, alkalies, herbicides, pesticides, and organic chemicals.

1.2.6 Garbage

Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2.7 Hazardous Waste

Hazardous waste as defined in 40 CFR 261 or as defined by applicable State and local regulations.

1.2.8 Oily Waste

Petroleum products and bituminous materials.

1.2.9 Regulated Waste

Those solid waste that have specific additional Federal, state, or local controls for handling, storage, or disposal.

1.2.10 Class I Ozone Depleting Substance (ODS)

Class I ODS is defined in Section 602(a) of The Clean Air Act and includes the following chemicals:

chlorofluorocarbon-11 (CFC-11)	chlorofluorocarbon-213 (CFC-213)
chlorofluorocarbon-12 (CFC-12)	chlorofluorocarbon-214 (CFC-214)
chlorofluorocarbon-13 (CFC-13)	chlorofluorocarbon-215 (CFC-215)
chlorofluorocarbon-111 (CFC-111)	chlorofluorocarbon-216 (CFC-216)
chlorofluorocarbon-112 (CFC-112)	chlorofluorocarbon-217 (CFC-217)
chlorofluorocarbon-113 (CFC-113)	halon-1211
chlorofluorocarbon-114 (CFC-114)	halon-1301
chlorofluorocarbon-115 (CFC-115)	halon-2402
chlorofluorocarbon-211 (CFC-211)	carbon tetrachloride
chlorofluorocarbon-212 (CFC-212)	methyl chloroform

1.2.11 Hazardous Materials

Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261. Throughout this specification, hazardous material includes hazardous chemicals.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

SD-06 Test Reports

Laboratory analysis

SD-11 Closeout Submittals

Some of the records listed below are also required as part of other submittals. For the "Records" submittal, maintain on-site a separate three-ring Environmental Records binder and submit at the completion of the project. Make separate parts to the binder corresponding to each of the applicable sub items listed below.

Preconstruction survey

Solid waste disposal permit

Waste determination documentation

Disposal documentation for hazardous and regulated waste

Contractor 40 CFR employee training records

Regulatory notification

Solid waste disposal report

Contractor Hazardous Material Inventory Log; G

1.4 REPORTS

1.4.1 Preconstruction Survey

Perform a preconstruction survey of the project site with the Contracting Officer, and take photographs showing existing environmental conditions in and adjacent to the site. Submit a report for the record.

1.4.2 Solid Waste Disposal Permit

Submit one copy of a State and local permit or license showing such agencies' approval of the disposal plan before transporting wastes off Government property.

1.4.3 Waste Determination Documentation

The Contractor shall complete a Waste Determination form (provided at the pre-construction conference) for all contractor derived wastes to be generated. The waste determination must be based upon either a constituent listing from the manufacturer used in conjunction with consideration of the process by which the waste was generated, EPA approved analytical data, or laboratory analysis (Material Safety Data Sheets (MSDS) by themselves are not adequate). All support documentation must be attached to the Waste Determination form. As a minimum, a Waste Determination form must be provided for the following wastes (this listing is not all inclusive): oil and latex based painting and caulking products, solvents, adhesives, aerosols, petroleum products, and all containers of the original materials.

1.4.4 Disposal Documentation for Hazardous and Regulated Waste

Submit a copy of the applicable EPA and State permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities.

1.4.5 Contractor 40 CFR Employee Training Records

Prepare and maintain employee training records throughout the term of the contract meeting applicable 40 CFR requirements. Submit these training records to the Contracting Officer at the conclusion of the project, unless otherwise directed.

1.4.6 Regulatory Notification

The Contractor is responsible for all regulatory notification requirements in accordance with Federal, State and local regulations. The Contractor shall forward copies to the Contracting Officer prior to commencement of work activities. Typically, regulatory notifications must be provided for the following (this listing is not all inclusive): demolition, renovation, NPDES defined site work, remediation of controlled substances (asbestos, hazardous waste, lead paint).

1.4.7 Solid Waste Disposal Report

Monthly the Contractor shall submit a solid waste disposal report to the Contracting Officer. For each waste, the report shall state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste. The Contractor shall include copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, the Contractor may submit a statement indicating the disposal location for the solid waste which is signed by an officer of the Contractor firm authorized to legally obligate or bind the firm. The

sales documentation or Contractor certification shall include the receiver's tax identification number and business, EPA or State registration number, along with the receiver's delivery and business addresses and telephone numbers. For each solid waste retained by the Contractor for his own use, the Contractor shall submit on the solid waste disposal report the information previously described in this paragraph. Prices paid or received shall not be reported to the Contracting Officer unless required by other provisions or specifications of this Contract or public law.

1.5 CLASS I ODS PROHIBITION

Class I ODS as defined and identified herein shall not be used in the performance of this contract, nor be provided as part of the equipment. This prohibition shall be considered to prevail over any other provision, specification, drawing, or referenced documents.

1.6 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, State, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

Environmental Brief: Attend an environmental brief to be included in the preconstruction meeting. Provide the following information: types, quantities, and use of hazardous materials that will be brought onto the activity; types and quantities of wastes/wastewater that may be generated during the contract.

1.6.1 Facility Hazardous Waste Generator Status

All work conducted within the boundaries of this activity must meet the regulatory requirements of this generator designation. The Contractor shall comply with all provisions of Federal, State and local regulatory requirements applicable to this generator status regarding training and storage, handling, and disposal of all construction derived wastes.

1.6.2 Licenses and Permits

Obtain licenses and permits pursuant to the "Permits and Responsibilities" FAR Clause.

For permits obtained by the Contracting Officer, whether or not required by the permit, the Contractor is responsible to perform quality control inspections of the work in progress, and to submit notifications and certifications to the applicable regulatory agency, via the Contracting Officer, that the work conforms to the contract and permit requirements. The inspections and certifications shall be provided through the services

of a Professional Engineer, registered in the State where the work is being performed. As a part of the quality control plan, which is required to be submitted for approval by the quality control section, provide a sub item containing the name, P.E. registration number, address, and telephone number of the professional engineer(s) who will be performing the inspections and certifications for each permit listed above.

1.7 CONTRACTOR HAZARDOUS MATERIAL INVENTORY LOG

Submit the "Contractor Hazardous Material Inventory Log" (copy at end of section), which provides information required by (EPCRA Sections 312 and 313) along with corresponding Material Safety Data Sheets (MSDS) to the Contracting Officer at the start and at the end of construction (30 days from final acceptance), and update no later than January 31 of each calendar year during the life of the contract. Documentation for any spills/releases, environmental reports or off-site transfers may be requested by the Contracting Officer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified.

3.1.1 Water Resources

3.1.1.1 Oily and Hazardous Substances

Prevent oil or hazardous substances from entering the ground, drainage areas, or navigable waters. In accordance with 40 CFR 112, surround all temporary fuel oil or petroleum storage tanks with a temporary berm or containment of sufficient size and strength to contain the contents of the tanks, plus 10 percent freeboard for precipitation. The berm shall be impervious to oil for 72 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs.

3.1.1.2 Stormwater Drainage

There shall be no discharge of excavation ground water to the sanitary sewer, storm drains, or to the river without prior specific authorization of the Environmental Programs Division in writing. Discharge of hazardous substances will not be permitted under any circumstances.

Construction site runoff shall be prevented from entering any storm drain or the river directly by the use of straw bales or other method suitable to the Environmental Programs Division of the Shipyard. Contractor shall

provide erosion protection of the surrounding soils.

3.2 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Carefully protect in-place and report immediately to the Contracting Officer historical and archaeological items or human skeletal remains discovered in the course of work. Upon discovery, notify the Contracting Officer. Stop work in the immediate area of the discovery until directed by the Contracting Officer to resume work. The Government retains ownership and control over historical and archaeological resources.

3.3 EROSION AND SEDIMENT CONTROL MEASURES

3.3.1 Burnoff

Burnoff of the ground cover is not permitted.

3.3.2 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified. Immediately protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

3.3.3 Temporary Protection of Erodible Soils

Use the following methods to prevent erosion and control sedimentation:

3.3.3.1 Mechanical Retardation and Control of Runoff

Mechanically retard and control the rate of runoff from the construction site. This includes construction of diversion ditches, benches, berms, and use of silt fences and straw bales to retard and divert runoff to protected drainage courses.

3.3.3.2 Sediment Basins

Trap sediment in temporary sediment basins. Pump dry and remove the accumulated sediment, after each storm. Use a paved weir or vertical overflow pipe for overflow. Remove collected sediment from the site. Institute effluent quality monitoring programs.

3.3.3.3 Vegetation and Mulch

Provide temporary protection on sides and back slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

- a. Seeding: Provide new seeding where ground is disturbed. Include topsoil or nutriment during the seeding operation necessary to

reestablish a suitable stand of grass.

3.4 CONTROL AND DISPOSAL OF SOLID WASTES

Pick up solid wastes, and place in covered containers which are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Recycling is encouraged and can be coordinated with the Contracting Officer and the activity recycling coordinator. Remove all solid waste (including non-hazardous debris) from Government property and dispose off-site at an approved landfill. Solid waste disposal off-site must comply with most stringent local, State, and Federal requirements including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

3.5 CONTROL AND DISPOSAL OF HAZARDOUS WASTES

3.5.1 Hazardous Waste/Debris Management

The Contractor shall identify all construction activities which will generate hazardous waste/debris. The Contractor must provide a documented waste determination for all resultant waste streams. Hazardous waste/debris shall be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State, and local regulations including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268. Hazardous waste shall also be managed in accordance with the approved Hazardous Waste Management Section of the Environmental Protection Plan. Store hazardous wastes in approved containers in accordance with 49 CFR 173 and 49 CFR 178. Hazardous waste generated within the confines of Government facilities shall be identified as being generated by the Government. Prior to removal of any hazardous waste from Government property, all hazardous waste manifests must be signed by activity personnel from the Station Environmental Office. No hazardous waste shall be brought onto Government property. Provide to the Contracting Officer a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-SUBPART D. For hazardous wastes spills, verbally notify the Contracting Officer immediately.

3.5.1.1 Regulated Waste Storage/Satellite Accumulation/90 Day Storage Areas

If the work requires the temporary storage/collection of regulated or hazardous wastes, the Contractor shall request the establishment of a Regulated Waste Storage Area, a Satellite Accumulation Area, or a 90 Day Storage Area at the point of generation. The Contractor must submit a request in writing to the Contracting Officer providing the following information:

<u>Contract Number</u>	_____	<u>Contractor</u>	_____
<u>Haz/Waste or</u> <u>Regulated Waste PO</u>	_____	<u>Phone Number</u>	_____
<u>Type of Waste</u>	_____	<u>Source of Waste</u>	_____

Emergency PO _____ Phone Numbe _____

Location of the Sit : _____
(Attach Site Plan to the Request)

Attach a waste determination form. Allow ten working days for processing this request.

3.5.1.2 Hazardous Waste Disposal

COMPLETE AS APPLICABLE WITH THE DETAILS OF THE CONTRACT. THE SECTIONS WITH () SHOULD BE MARKED AS APPLICABLE WITH AN 'X'.

Controlled of stored waste, packaging, sampling, analysis, and disposal shall b determined by the details in the contract. The requirements for jobs in the following paragraphs shall be used as the guidelines for disposal of any hazardous waste generated.

(a) Responsibilities for Contractor's Disposal

Any generation of WHM/HW requiring Contractor disposal of solid waste or liquid.

- a. The Contractor agrees to provide all service necessary for the final treatment/disposal of the hazardous material/waste in accordance with all local, State and Federal laws and regulations, and the terms and conditions of the contract within sixty (60) days after the materials have been generated. These services shall include all necessary personnel, labor, transportation, packaging, detailed analysis (if required for disposal, and/or transportation, including manifesting or completing waste profile sheets, equipment, and the compilation of all documentation is required).
- b. Contain all waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, 40 CFR 268, 40 CFR 270, 40 CFR 272, 40 CFR 273, 40 CFR 279, 40 CFR 280, and 40 CFR 761.
- c. Control and turn in all hazardous waste requiring disposal in accordance with Norfolk Naval Shipyard Recovery Material Instruction contained in this specification entitled "Contractor Disposal Turn-In Requirements".
- d. Obtaining a representative sample of the material generated for each job done to provide waste stream determination.
- e. Analyzing for each sample taken and providing analytical results to the Contracting Officer. Provide two copies of the results.
- f. Determine the DOT proper shipping names for all waste (each container requiring disposal) and shall demonstrate how this determination is developed and supported by the sampling and

analysis requirements contained herein to the Contracting Officer for Code 106's review.

Government Responsibilities

To review all documentation submitted by the Contractor for accuracy. Provide guidance to the Contractor in reference to environmental compliance.

Interim Waste Generation Site for Contractor Disposal of WHM/HW

The Contractor shall request approval of the Government for an area suitable for packaging WHM/HW requiring disposal. The Contractor shall comply with the requirements of the Virginia Department of Waste Management Regulations. The area will be barricaded and a sign identifying as follows:

Signage- "DANGER - UNAUTHORIZED PERSONNEL KEEP OUT"

With additional custody sign indicating:

- (1) Site #
- (2) Controlled by

Barricade Type: Yellow and black three (3) inch plastic tape. Corner barricades shall be provided by the Government.

Contractor Disposal Turn-In Requirements

For any waste hazardous materials or hazardous waste generated which requires the Contractor to dispose of, the following conditions must be complied with:

- a. Call Code 106.322 dispatcher, at 396-7231 ext. 161 and provide the following information:
 - (1) Your name and company
 - (2) Service/contract number
 - (3) ROICC/Code 460 number
 - (4) Telephone number where you can be reached
 - (5) Material requiring disposal
 - (6) Location of material
 - (7) Volume of material in each container
- b. All material must meet the following conditions in order to be acceptable for disposal
 - (1) Drums compatible with waste contents and drums meet DOT requirements for 49 CFR 173 for transportation of materials.

(2) Drums banded to wooden pallets. No more than three (3) 55 gallon drum to a pallet, or two (2) 85 gallon over packs.

(3) Band using 1-1/4 inch minimum band on upper third of drum.

(4) Recovery materials label (provided by Code 106.321) located in middle of drum, filled out to indicate actual volume of material, name of material manufacturer, other vendor information as available.

(5) Always have three (3) to five (5) inches of empty space above volume of material. This space is called 'outage'.

(b) Responsibilities for Government's Disposal

Any generation of WHM/HW requiring Government disposal of solid waste or liquid.

Contractor's Representative

- a. Contain all waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, 40 CFR 268, 40 CFR 270, 40 CFR 271, 40 CFR 272, 40 CFR 273, 40 CFR 279, 40 CFR 280, and 40 CFR 716.
- b. Control and turn-in all hazardous waste requiring disposal in accordance with NNSY Recovery Material Instruction contained in the specification entitled "Government Disposal Turn-In Requirements".
- c. Providing identification of material requiring disposal to permit safe opening, storage and handling by the Government.

Government Responsibilities

- a. Sample material requiring disposal.
- b. Analyzing each sample taken.
- c. Determine the DOT proper shipping names for all waste (each container requiring disposal) and shall demonstrate how this determination is developed and supported by the sampling and analysis requirements.
- d. Accepting and disposing of all WHM/HW properly turned in by the Contractor for disposal.

Acceptance of WHM/HW for Disposal

Upon completion of all above applicable requirements (i.e. sample, analysis, identification, packaging, etc.), the Contractor shall notify the Contracting Officer three (3) working days in advance for review and acceptance by the Environmental Programs Division, Code 106.3. The Contractor shall correct all discrepancies not conforming to this contract

at his expense. Upon acceptance by the Environmental Programs, the waste will be removed from the Contractor's work site within three (3) days.

Interim Waste Generation Site for Government Disposal of WHM/HW

The Contractor shall request approval of the Government for an area suitable for packaging WHM/KHW requiring disposal. The area will be barricaded and a sign identifying as follows:

Signage- "DANGER - UNAUTHORIZED PERSONNEL KEEP OUT"

With additional custody sign indicating:

- (1) Site #
- (2) Controlled by

Barricade Type: Yellow and black three (3) inch plastic tape. Corner barricades shall be provided by the Government.

Government Disposal Turn-In Requirements

- a. Call Code 106.322 dispatcher, at 396-7231 ext. 161 and provide the following information:
 - (1) Your name and company
 - (2) Service/contract number
 - (3) ROICC/Code 460 contact number
 - (4) Telephone Number where you can be reached
 - (5) Material requiring disposal
 - (6) Location of material
 - (7) Volume of material in each container
- b. All material must meet the following conditions in order to be acceptable for disposal:
 - (1) Drums compatible with waste contents and drums meet DOT requirements for 40 CFR 173 for transportation of materials.
 - (2) Drums banded to wooden pallets. No more than three (3) 55 gallon drums to pallet, or two (2) 85 gallon over packs.
 - (3) Band using 1-1/4 inch minimum band on upper third of drum.
 - (4) Recovery materials label (provided by Code 106.321) located in middle of drum, filled out to indicate actual volume of material, name of material manufacturer, other vendor information as available.

(5) Always have three (3) to five (5) inches of empty space above volume of material. This space is called 'outage'.

(6) Code 106.321 must be notified within 24 hours of filling any drum of material requiring disposal. Date on recovery material label shall be Code 106.321 notification date

3.5.2 Pollution Prevention/Hazardous Waste Minimization

The Contractor shall actively pursue minimizing the use of hazardous materials and the generation of hazardous waste while on-base. The Hazardous Waste Management Section of the Environmental Protection Plan shall include the Contractor's procedures for pollution prevention/hazardous waste minimization. For preparing this part of the plan, the Contractor may consult the activity Environmental Office for suggestions and to obtain a copy of the installation's pollution prevention/hazardous waste minimization plan for reference material. If no written plan exists, the Contractor may obtain information by contacting the Contracting Officer. The Contractor shall describe the types of the hazardous materials expected to be used in the construction when requesting information.

3.5.3 Hazardous Material Control

The Contractor shall include hazardous material control procedures in the Safety Plan. The procedures shall address and ensure the proper handling of hazardous materials, including the appropriate transportation requirements. The Contractor shall submit a MSDS and estimated quantities to be used for each hazardous material to the Contracting Officer prior to bringing the material on base. Typical materials requiring MSDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum products. At the end of the project, the Contractor shall provide the Contracting Officer with the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the project, and how the material was used. The Contractor shall also ensure that hazardous materials are utilized in a manner that will minimize the amount of hazardous waste that is generated. The Contractor shall ensure that all containers of hazardous materials have NFPA labels or their equivalent. Copies of the MSDS for hazardous materials shall be kept on site at all times and provided to the Contracting Officer at the end of the project. The Contractor shall certify that all hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste per 40 CFR 261.

3.5.4 Petroleum Products

Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. All used oil generated on site shall be managed in accordance with 40 CFR 279. The Contractor shall determine if any used oil generated while on-site exhibits a characteristic of hazardous waste. In addition, used oil containing 1000 parts per million of solvents will be considered a hazardous waste and

disposed of at Contractor's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste. All hazardous waste will be managed in accordance with the paragraph entitled Hazardous Waste/Debris Management of this section and shall be managed in accordance with the approved Environmental Protection Plan.

3.5.5 Releases/Spills of Oil and Hazardous Substances

Take precautions to prevent releases/spills of oil and hazardous substances. In the event of any releases of oil and hazardous substances, chemicals, or gases; immediately (within 15 minutes) notify the Base or Activity Fire Department, the activity's Command Duty Officer, and the Contracting Officer. The Contractor is responsible for verbal and written notifications as required by the federal 40 CFR 355, State, local regulations and Navy Instructions. Spill response shall be in accordance with 40 CFR 300 and applicable State and local regulations. Contain and clean up these spills without cost to the Government. If Government assistance is requested or required, the Contractor shall reimburse the Government for such assistance. Provide copies of the written notification and documentation that a verbal notification was made within 20 days.

3.6 DUST CONTROL

Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster.

3.7 ABRASIVE BLASTING

3.7.1 Blasting Operations

The use of silica sand is prohibited in sandblasting.

Provide tarpaulin drop cloths and windscreens to enclose abrasive blasting operations to confine and collect dust, abrasive, agent, paint chips, and other debris. Perform work involving removal of hazardous material in accordance with 29 CFR 1910.

3.7.2 Disposal Requirements

Submit analytical results of the debris generated from abrasive blasting operations per paragraph entitled Laboratory Analysis of this section. Hazardous waste generated from blasting operations shall be managed in accordance with paragraph entitled "Hazardous Waste\Debris Management" of this section and with the approved HWMP. Disposal of non-hazardous abrasive blasting debris shall be in accordance with paragraph entitled, "Control and Disposal of Solid Wastes".

3.8 NOISE

Make the maximum use of low-noise emission products, as certified by the EPA. Blasting or use of explosives will not be permitted without written permission from the Contracting Officer, and then only during the designated times.

-- End of Section --

SECTION 01580

PROJECT IDENTIFICATION
03/98

PART 1 GENERAL

1.1 REFERENCES

The publication listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1 (1996) All Timber Products - Preservative Treatment by Pressure Processes

AWPA C2 (1996) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

1.2 PROJECT SIGN

Within 15 days after the commencement of work, provide one project identification sign at the location indicated . Construct the sign in accordance with project sign detail attached at the end of this section. Maintain sign throughout the life of the project. Upon completion of the project, remove the sign from the site. Government will supply the Public Works 18 inches logo sticker.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01770

CLOSEOUT PROCEDURES
09/99

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-10 Operation and Maintenance Data

Equipment/product warranty list

Submit Data Package 1 in accordance with Section 01781, "Operation and Maintenance Data."

SD-11 Closeout Submittals

As-built drawings; G

Record of materials; G

Utility as-built drawings; G

Equipment/product warranty tag; G

1.2 Utility As-Built Drawings

In addition to as-built drawings provide for each exterior utility system a set of reproducible utility drawings, stamped and signed by a registered professional civil engineer or professional land surveyor, and two copies. Submit within ten working days after each system is in place, but no later than five working days before final inspection. Indicate exterior utilities from a point five feet from a building to the termination point or point of connection to existing system. Include the following:

- a. Horizontal and vertical controls for new utilities and existing utilities exposed during construction. Reference to station's horizontal and vertical control system.
- b. Sufficient dimensional control for all important features such as beginning and termination points, points of connection, inverts for sewer lines and drainage collection systems, top of pipe or conduit runs, manholes, cathodic protection appurtenances, valves, valve stem tops, backflow preventers, and other significant features.
- c. Indicate type and size of all materials used in the construction of the system.

- d. Indicate bearing and distance on tangent lines. On curves, indicate delta and radius of the curve, also provide X, Y, and Z coordinates at all BC and EC angle points. Indicate horizontal and vertical control for all intersecting and tangent points where utility alignment changes. Indicate X, Y, and Z coordinates at building line and point of connection for straight building laterals or services under 40 feet.
- e. Tolerances: Horizontal and vertical control dimensions, plus or minus 0.10 foot. Angular control, plus or minus 0 degrees 01 minute.

1.3 PROJECT RECORD DOCUMENTS

1.3.1 As-Built Drawings

"FAC 5252.236-9310, Record Drawings." In addition to the requirements of FAC 5252.236-9310, the Contractor shall survey the horizontal and vertical location of all underground utilities to within 0.1 feet relative to the station datum. All pipe utilities shall be surveyed at each fitting and every 100 LF of run length. Electrical and communication duct bank, direct buried conduit, and direct buried conductor shall be surveyed every 100 LF and at each change of direction. Locations and elevations shall be recorded on the Record Drawings. Submit drawings with QC certification.

1.3.2 As-Built Record of Materials

Furnish a record of materials.

Where several manufacturers' brands, types, or classes of the item listed have been used in the project, designate specific areas where each item was used. Designations shall be keyed to the areas and spaces depicted on the contract drawing. Furnish the record of materials used in the following format:

MATERIALS DESIGNATION	SPECIFICATION	MANUFACTURER	MATERIALS USED (MANUFACTURER'S DESIGNATION)	WHERE USED
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1.4 EQUIPMENT/PRODUCT WARRANTIES

1.4.1 Equipment/Product Warranty List

Furnish to the Contracting Officer a bound and indexed notebook containing written warranties for equipment/products furnished under the contract, and prepare a complete listing of such equipment/products. The equipment/products list shall state the specification section applicable to the equipment/product, duration of the warranty therefor, start date of the warranty, ending date of the warranty, and the point of contact for fulfillment of the warranty. The warranty period shall begin on the same date as project acceptance and shall continue for the full product warranty period. Execute the full list and deliver to the Contracting Officer prior

to final acceptance of the facility.

1.4.2 Equipment Warranty Tags and Guarantor's Local Representative

Furnish with each warranty the name, address, and telephone number of the guarantor's representative nearest to the location where the equipment and appliances are installed. The guarantor's representative, upon request of the station representative, shall honor the warranty during the warranty period, and shall provide the services prescribed by the terms of the warranty. At the time of installation, tag each item of warranted equipment with a durable, oil- and water-resistant tag approved by the Contracting Officer. Attach tag with copper wire and spray with a clear silicone waterproof coating. Leave the date of acceptance and QC's signature blank until project is accepted for beneficial occupancy. Tag shall show the following information:

EQUIPMENT/PRODUCT WARRANTY TAG

Type of Equipment/Product _____
Warranty Period _____ From _____ To _____
Contract No. _____
Inspector's Signature _____ Date Accepted _____

Construction Contractor:

Name: _____
Address: _____
Telephone: _____

Warranty Contact: _____
Name: _____
Address: _____
Telephone: _____

STATION PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE

1.5 MECHANICAL TESTING AND BALANCING

All contract requirements of Section 15949, "HVAC Testing/Adjusting/Balancing for Small Systems," shall be fully completed, including testing and inspection, prior to contract completion date, except as noted otherwise in Section 15949. The time required to complete all work and testing as prescribed by Section 15949 is included in the allotted calendar days for completion.

1.6 CLEANUP

Leave premises "broom clean." Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces. Clean equipment and fixtures to a sanitary condition. Clean or Replace filters of operating equipment. Clean debris from roofs. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01781

OPERATION AND MAINTENANCE DATA
03/98

PART 1 GENERAL

1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data/Manuals which are specifically applicable to this contract and a complete and concise depiction of the provided equipment or product. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01330, "Submittal Procedures."

1.1.1 Quantity

Submit five sets of the supplier/manufacturers' O&M information specified herein for the components, assemblies, subassemblies, attachments, and accessories. The items for which O&M Data/Manuals are required are listed in the technical sections which specifies those particular items.

1.1.2 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.1.3 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." For each product, system, or component piece of equipment requiring submission of O&M Data, submit the Data Package specified in the individual technical section.

1.1.4 Delivery

Submit O&M Data Manuals to the Contracting Officer for review and acceptance; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

- a. In the event the Contractor fails to deliver O&M Data/Manuals within the time limits set forth above, the Contracting Officer may withhold from progress payments 50 percent of the price of the item with which such O&M Data/Manuals are associated.

1.1.5 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data,

shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.2 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.2.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation:

1.2.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.2.1.2 Operator Pre start

Include procedures required to set up and prepare each system for use.

1.2.1.3 Startup, Shutdown, and Post shutdown Procedures

Provide narrative description for each operating procedure including control sequence for each.

1.2.1.4 Normal Operations

Provide narrative description of normal operating procedures. Include control diagrams with data to explain operation and control of systems and specific equipment.

1.2.1.5 Emergency Operations

Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.

1.2.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and gage reading recording.

1.2.1.7 Environmental Conditions

Include a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

1.2.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance

to minimize corrective maintenance and repair.

1.2.2.1 Lubrication Data

Include lubrication data, other than instructions for lubrication in accordance with paragraph titled "Operator Service Requirements":

- a. A table showing recommended lubricants for specific temperature ranges and applications;
- b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and
- c. A lubrication schedule showing service interval frequency.

1.2.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.2.3 Corrective Maintenance (Repair)

Include manufacturer's recommendations on procedures and instructions for correcting problems and making repairs.

1.2.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.2.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation numbering.

1.2.3.3 Maintenance and Repair Procedures

Include instructions and list tools required to restore product or equipment to proper condition or operating standards.

1.2.3.4 Removal and Replacement Instructions

Include step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.2.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.

1.2.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

1.2.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.2.6 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies. Parts data may cover more than one model or series of equipment. components, assemblies, subassemblies, attachments, or accessories, such as a master parts catalog, in accordance with the manufacturer's standard commercial practice.

1.2.6.1 Warranty Information

List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.2.6.2 Personnel Training Requirements

Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.

1.2.6.3 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.2.6.4 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each subcontractor installing the product or equipment. Include local representatives and service organizations most convenient to the project site. Provide the name, address, and telephone number of the product or equipment manufacturers.

1.3 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M Data Packages specified in individual technical sections. The required information for each O&M Data Package is as follows:

1.3.1 Data Package 1

- a. Safety precautions
- b. Maintenance and repair procedures
- c. Warranty information
- d. Contractor information

1.3.2 Data Package 2

- a. Safety precautions
- b. Normal operations
- c. Environmental conditions
- d. Lubrication data
- e. Preventive maintenance plan and schedule
- f. Maintenance and repair procedures
- g. Removal and replacement instructions
- h. Spare parts and supply list
- i. Parts identification

- j. Warranty information
- k. Contractor information

1.3.3 Data Package 3

- a. Safety precautions
- b. Normal operations
- c. Emergency operations
- d. Environmental conditions
- e. Lubrication data
- f. Preventive maintenance plan and schedule
- g. Troubleshooting guides and diagnostic techniques
- h. Wiring diagrams and control diagrams
- i. Maintenance and repair procedures
- j. Removal and replacement instructions
- k. Spare parts and supply list
- l. Parts identification
- m. Warranty information
- n. Testing equipment and special tool information
- o. Contractor information

1.3.4 Data Package 4

- a. Safety precautions
- b. Operator prestart
- c. Startup, shutdown, and post shutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Operator service requirements
- g. Environmental conditions
- h. Lubrication data

- i. Preventive maintenance plan and schedule
- j. Troubleshooting guides and diagnostic techniques
- k. Wiring diagrams and control diagrams
- l. Maintenance and repair procedures
- m. Removal and replacement instructions
- n. Spare parts and supply list
- o. Corrective maintenance man-hours
- p. Parts identification
- q. Warranty information
- r. Personnel training requirements
- s. Testing equipment and special tool information
- t. Contractor information

1.3.5 Data Package 5

- a. Safety precautions
- b. Operator prestart
- c. Start-up, shutdown, and post shutdown procedures
- d. Normal operations
- e. Environmental conditions
- f. Preventive maintenance plan and schedule
- g. Troubleshooting guides and diagnostic techniques
- h. Wiring and control diagrams
- i. Maintenance and repair procedures
- j. Spare parts and supply list
- k. Testing equipments and special tools
- l. Warranty information
- m. Contractor information

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 02315

EXCAVATION AND FILL
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1997) Concrete Aggregates
ASTM C 136	(1996; Rev. A) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D 1140	(1997) Amount of Material in Soils Finer Than the No. 200 (75-Micrometer) Sieve
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m))
ASTM D 2321	(1989; R 1995) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1996) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995; Rev. A) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600 (1993) Installation of Ductile-Iron Water
Mains and Their Appurtenances

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909 Fertilizer

CORPS OF ENGINEERS (COE)

COE EM-385-1-1 (1996) Safety and Health Requirements
Manual

1.2 DEFINITIONS

1.2.1 Cohesive Materials

Materials ASTM D 2487 classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

1.2.2 Cohesionless Materials

Materials ASTM D 2487 classified as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-06 Test Reports

Borrow Site Testing; G

Fill and backfill test

Select material test

Porous fill test for capillary water barrier

Density tests

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations are as indicated.
- b. Pipes or other artificial obstructions, except those indicated, will not be encountered.
- c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.
- d. Material character is indicated by the boring logs.
- e. Hard materials will not be encountered.
- f. Blasting will not be permitted. Remove material in an approved manner.

1.6 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 1 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX). Provide Borrow Site Testing for TPH and BTEX from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the Contracting Officer.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.1 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.2 Backfill and Fill Material

ASTM D 2487, classification GW, GP, GM, GC, SW, SP, SM, SC with a maximum ASTM D 4318 liquid limit of 35, maximum ASTM D 4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.3 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.1.4 Select Material

ASTM D 2487, classification GW, GP, SW, SP.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C 33 fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve, or coarse aggregate Size 57, 67, or 77 and conforming to the general soil material requirements specified in paragraph entitled "Soil Materials."

2.3 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

2.4 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems

2.4.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.4.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.5 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Stripping

Strip existing topsoil to a depth of 4 inches without contamination by subsoil material. Stockpile topsoil separately from other excavated material and locate convenient to finish grading area.

3.1.2 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.1.2.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade of the building with six passes of a loaded dump truck. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 miles per hour. When proof rolling under buildings, the building subgrade shall be considered to extend 5 feet beyond the building lines, and one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer. Rutting or pumping of material shall be undercut as directed by the Contracting Officer.

3.2 PROTECTION

3.2.1 Protection Systems

Provide shoring, bracing, and sheeting in accordance with COE EM-385-1-1 , except that banks may be sloped only when approved by the Contracting Officer.

3.2.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.2.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 1.0 feet below the working level.

3.2.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.

3.2.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Refill with select material and compact to 95 percent of ASTM D 698 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with select material and compact to 95 percent of ASTM D 698 maximum density.

3.3.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Fill overexcavations with concrete during foundation placement.

3.3.2 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement.

3.4 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.4.1 Common Fill Placement

Provide for general site . Place in 6 inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.4.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6 inch lifts. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.4.3 Select Material Placement

Provide under porous fill of structures not pile supported. Place in 6 inch lifts. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when

approved. Place and compact material to avoid loading upon or against structure.

3.4.4 Porous Fill Placement

Provide under floor slab on a compacted subgrade. Place in 4 inch lifts.

3.4.5 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one foot over pipe outside structures and paved areas.

3.4.5.1 Bedding Requirements

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D 2321 materials as follows:

- a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
- b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

3.5 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.6 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to cleanout. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over its entire length.

3.7 COMPACTION

Expressed as a percentage of maximum density. Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required.

3.7.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the structure to 85 percent of ASTM D 698.

3.7.2 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D 698. Compact common fill, fill and backfill material and select material to 95 percent of ASTM D 698.

3.7.3 Porous Fill for Capillary Water Barrier

Compact with two passes of a hand-operated, plate type vibratory compactor.

3.7.4 Adjacent Area

Compact areas within 5 feet of structures to 90 percent of ASTM D 698.

3.7.5 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D 698. Compact fill and backfill materials to 95 percent of ASTM D 698.

3.8 FINISH OPERATIONS

3.8.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.8.2 Seed

Scarify existing subgrade. Provide 4 inches of topsoil for newly graded finish earth surfaces and areas disturbed by the Contractor. If there is insufficient on-site topsoil meeting specified requirements for topsoil, provide topsoil required in excess of that available. Seed shall match existing vegetation. Provide seed at 5 pounds per 1000 square feet. Provide CID A-A-1909, Type I, Class 2, 10-10-10 analysis fertilizer at 25 pounds per 1000 square feet. Provide commercial agricultural limestone of 94-80-14 analysis at 70 pounds per 1000 square feet. Provide mulch and water to establish an acceptable stand of grass.

3.8.3 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.9 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots,

and timber.

3.10 FIELD QUALITY CONTROL

3.10.1 Sampling

Take the number and size of samples required to perform the following tests.

3.10.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.10.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 4318 for liquid limit and for plastic limit; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.10.2.2 Select Material Testing

Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.10.2.3 Porous Fill Testing

Test porous fill in accordance with ASTM C 136 for conformance to gradation specified in ASTM C 33.

3.10.2.4 Density Tests

Test density in accordance with ASTM D 1556, or ASTM D 2922 and ASTM D 3017.

When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 1556 density test at a location already ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 1556 density test at the start of the job, and for every 10 ASTM D 2922 and ASTM D 3017 density tests thereafter. Test each lift at randomly selected locations every 1500 square feet of existing grade in fills for structures and concrete slabs, and every 1500 square feet for other fill areas.

-- End of Section --

SECTION 02510

WATER DISTRIBUTION
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.18 (1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings

ANSI B18.5.2.1M (1981; R 1995) Metric Round Head Short Square Neck Bolts

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA MRE (1994) Manual for Railway Engineering (Fixed Properties)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.1 (1996) Cast Iron Pipe Flanges and Flanged Fittings

ANSI/ASME B16.3 (1992) Malleable Iron Threaded Fittings

ANSI/ASME B16.4 (1992) Gray Iron Threaded Fittings

ASME/ANSI B16.22 (1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME/ANSI B16.26 (1988) Cast Copper Alloy Fittings for Flared Copper Tubes

ASME/ANSI B18.2.2 (1987; R 1993) Square and Hex Nuts (Inch Series)

ANSI/ASME B18.5.2.2M (1982; R 1993) Metric Round Head Square Neck Bolts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47M (1990; R 1996) Ferritic Malleable Iron Castings (Metric)

ASTM A 47 (1990; R 1995) Ferritic Malleable Iron

Castings

ASTM A 48M	(1994) Gray Iron Castings (Metric)
ASTM A 48	(1994; Rev. A) Gray Iron Castings
ASTM A 53	(1995) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 563M	(1996) Carbon and Alloy Steel Nuts (Metric)
ASTM A 563	(1996) Carbon and Alloy Steel Nuts
ASTM A 746	(1995) Ductile Iron Gravity Sewer Pipe
ASTM B 32	(1995; Rev. A) Solder Metal
ASTM B 42	(1993) Seamless Copper Pipe, Standard Sizes
ASTM B 61	(1993) Steam or Valve Bronze Castings
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 88M	(1995) Seamless Copper Water Tube (Metric)
ASTM B 88	(1995) Seamless Copper Water Tube
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 150	(1997; Rev. A) Portland Cement
ASTM D 1527	(1994) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80
ASTM D 1785	(1996; Rev. B) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2235	(1996; Rev. A) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2241	(1996; Rev. B) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2282	(1994) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe
ASTM D 2466	(1997) Poly(Vinyl Chloride) (PVC) Plastic

Pipe Fittings, Schedule 40

ASTM D 2468	(1993) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1993) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1993) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3139	(1996; Rev. A) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1996; Rev. A) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(1993) Polyethylene Encasement for Ductile - Iron Pipe Systems
AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm), for Water and Other Liquids
AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153/A21.53	(1994) Ductile-Iron Compact Fittings, 3 in. Through 24 in. (76 mm Through 610 mm) and 54 in. Through 64 in. (1,000 mm Through 1,600 mm), for Water Service
AWWA C200	(1991) Steel Water Pipe 6 in. (150 mm) and Larger

AWWA C203	(1991) Coal-Tar Protective Coatings and Lining for Steel Water Pipelines - Enamel and Tape - Hot Applied
AWWA C205	(1989) Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. and Larger - Shop Applied
AWWA C206	(1991) Field Welding of Steel Water Pipe
AWWA C207	(1994; Erratum 1994) Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm)
AWWA C208	(1983; Addendum 1984, R 1989) Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	(1990) Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C210	(1992) Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C300	(1989; Addendum 1993) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
AWWA C301	(1992) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
AWWA C303	(1987; Erratum 1988) Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids
AWWA C500	(1993) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(1994) Dry-Barrel Fire Hydrants
AWWA C503	(1988) Wet-Barrel Fire Hydrants
AWWA C508	(1993) Swing-Check Valves for Waterworks Service, 2 in. (50 mm) Through 24 in. (600 mm) NPS
AWWA C509	(1994) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1992) Disinfecting Water Mains
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA C900	(1989; Addendum 1992) Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution
AWWA C906	(1990) Polyethylene (PE) Pressure Pipe and Fittings, 4 in. Through 63 in., for Water Distribution
AWWA M9	(1995) Concrete Pressure Pipe
AWWA M11	(1989) Steel Pipe - A Guide for Design and Installation
AWWA M23	(1980) PVC Pipe - Design and Installation

FEDERAL SPECIFICATIONS (FS)

FS WW-P-460	(Rev. D) Pipe Fittings; Brass or Bronze (Threaded) Classes 125 and 250 Pound
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
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UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	(1988) Installation of Polyvinyl Chloride (PVC) Pressure Pipe
UBPPA UNI-B-8	(1986) Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe

UNDERWRITERS LABORATORIES INC. (UL)

UL 246	(1993; R 1994, Bul. 1994) Hydrants for Fire-Protection Service
UL 262	(1994) Gate Valves for Fire-Protection Service

UL 312	(1993; R 1994) Check Valves for Fire-Protection Service
UL 405	(2000) Fire Protection Equipment
UL 789	(1993; R 1994) Indicator Posts for Fire-Protection Service

1.2 DESIGN REQUIREMENTS

1.2.1 Water Distribution Mains

Provide water distribution mains indicated as 4 through 12 inch diameter pipe sizes of ductile-iron or polyvinyl chloride (PVC) plastic pipe. Also provide water main accessories, gate valves as specified and where indicated.

1.2.2 Water Service Lines

Provide water service lines indicated as less than 4 inch lines from water distribution main to building service at a point approximately 5 feet from building. Water service lines shall be polyvinyl chloride (PVC) plastic pipe or acrylonitrile-butadiene-styrene (ABS) plastic pipe. Provide water service line appurtenances as specified and where indicated.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Piping Materials

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Hydrants

Indicator posts

Corporation stops

Valve boxes

Fire Department Connection

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry, do not drag pipe to the trench. Store plastic piping, jointing materials and rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

- a. Pipe and Fittings: Pipe, ANSI/AWWA C151/A21.51, Pressure Class 350 . Fittings, AWWA C110/A21.10 or AWWA C153/A21.53 ; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness.

- b. Joints and Jointing Material:

(1) Joints: Joints for pipe and fittings shall be push-on joints or mechanical joints. Joints made with sleeve-type mechanical coupling may be used in lieu of push-on joint, subject to the limitations specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

(2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

(3) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

(4) Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Piping

- a. Pipe and Fittings: Pipe, AWWA C900, shall be plain end or gasket bell end, Pressure Class 150 (DR 18) or Class 200 (DR 14) for fire department connection line with cast-iron-pipe-equivalent OD. Fittings shall be gray iron or ductile iron, AWWA C110/A21.10 or AWWA C153/A21.53, and have cement-mortar lining, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe specified in this paragraph.
- b. Joints and Jointing Material: Joints for pipe shall be push-on joints, ASTM D 3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints ASTM D 3139, or compression-type joints/mechanical joints, ASTM D 3139 and AWWA C111/A21.11. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints. Mechanically coupled joints using a sleeve-type mechanical coupling, as specified in paragraph entitled "Sleeve-Type Mechanical Couplings," may be used as an optional jointing method in lieu of push-on joints on plain-end PVC plastic pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling and to the use of internal stiffeners as specified for compression-type joints in ASTM D 3139.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends, and (3) UL 262 shall be inside-screw type with

operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 175 psi, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have O-ring stem seals, except for those valves for which gearing is specified, in which case use conventional packing in place of O-ring seal. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of mechanical-joint ends and push-on joint ends, valves may have special ends for connection to sleeve-type mechanical coupling. Valve ends and gaskets for connection to sleeve-type mechanical coupling shall conform to the applicable requirements specified for the coupling. Where a post indicator is shown, the valve shall have an indicator post flange; indicator post flange for AWWA C500 valve shall conform to the applicable requirements of UL 262. Valves shall be of one manufacturer.

2.1.2.2 Fire Hydrants

Dry-barrel type. Paint hydrants with at least one coat of primer and two coats of yellow enamel paint. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

- a. Dry-Barrel Type Fire Hydrants: Dry-barrel type hydrants, AWWA C502 or UL 246, "Base Valve" design, shall have 6 inch inlet, 5 1/4 inch valve opening, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections. Inlet shall have mechanical-joint or push-on joint end; end shall conform to the applicable requirements as specified for the joint. Size and shape of operating nut, cap nuts, and threads on hose and pumper connections shall be as specified in AWWA C502 or UL 246. Hydrants shall be "traffic type," and shall have frangible sections as mentioned in AWWA C502. The hydrant shall have special couplings joining upper and lower sections of hydrant barrel and shall be designed to have the special couplings break from a force not less than that which would be imposed by a moving vehicle; hydrant shall operate properly under normal conditions.

2.1.2.3 Indicator Posts

UL 789. Provide for gate valves where indicated.

2.1.2.4 Valve Boxes

Provide a valve box for each gate valve, except where indicator post is shown. Valve boxes shall be of cast iron or precast concrete of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches.

2.1.2.5 Sleeve-Type Mechanical Couplings

Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. For ductile iron and PVC plastic pipe, the middle ring shall be of cast-iron. Cast iron, ASTM A 48, not less than Class 25. Malleable and ductile iron shall, conform to ASTM A 47 and ASTM A 536, respectively. Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Bolts shall be track-head type, ASTM A 307, Grade A, with nuts, ASTM A 563, Grade A; or round-head square-neck type bolts, ANSI B18.5.2.1M and ANSI/ASME B18.5.2.2M with hex nuts, ASME/ANSI B18.2.2. Bolts shall be 5/8 inch in diameter; minimum number of bolts for each coupling shall be 5 for 6 inch pipe, and 6 for 8 inch pipe. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint.

2.1.2.6 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

2.1.2.7 Fire Department Connection

Exposed, Freestanding, Fire Department Connections: UL 405, cast-bronze body, with thread inlets according to NFPA 24 and matching local fire department hose threads, and threaded bottomoutlet. Include lugged caps, gaskets, and chains; lugged swivel connection and Drop clasper for each hose-connection inlet. Provide Knox Box Fire Department caps with 4 keys

- a. Connection: Two NPS 2- 1/2 inlets and one NPS 4 outlet.
- b. Inlet Alignment: Square.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

- a. Polyvinyl Chloride (PVC) Plastic Piping: ASTM D 1785, Schedule 40; or ASTM D 2241, with SDR as necessary to provide 150 psi minimum pressure rating. Fittings, ASTM D 2466. Pipe and fittings shall be of the same PVC plastic material and shall be

one of the following pipe/fitting combinations, as marked on the pipe and fitting, respectively: PVC 2120/PVC II; PVC 2116/PVC II. Solvent cement for jointing, ASTM D 2564.

- b. Acrylonitrile-butadiene-styrene (ABS) Plastic Piping: ASTM D 1527 or ASTM D 2282, with pipe schedule or SDR as necessary to provide 150 psi minimum pressure rating. Fittings, ASTM D 2468, as required to provide barrel wall thickness not less than that of the pipe. Solvent cement for jointing, ASTM D 2235.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Corporation Stops

Ground key type; bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be suitable for flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800.

2.2.2.2 Gate Valves

Gate valves smaller than 3 inch size MSS SP-80, Class 150, solid wedge, nonrising stem. Valves shall have flanged or threaded end connections, with a union on one side of the valve. Provide handwheel operators.

2.2.2.3 Valve Boxes

Provide a valve box for each gate valve. Valve boxes shall be of cast iron of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section at a point approximately 5 feet from the building. Do not lay water lines in the same trench with electric wiring.

- a. Water Piping Installation Parallel With Sewer Piping

- (1) Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

(2) Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

(1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

(2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02315, "Excavation and Fill.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe

accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where indicated and where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 2 1/2 feet.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped and as indicated.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

- a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer.

- b. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage . Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.
- c. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using Class A polyethylene film, in accordance with AWWA C105/A21.5.

3.1.1.2.2 Installation of PVC Plastic Water Main Pipe

Installation of PVC Plastic Water Main Pipe and Associated Fittings: Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines"; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

- a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UBPPA UNI-B-3 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.
- b. Pipe Anchorage: Provide concrete thrust blocks (reaction backing)

for pipe anchorage except where restrained joint is indicated. Thrust blocks shall be in accordance with the requirements of UBPPA UNI-B-3 for reaction or thrust blocking and plugging of dead ends, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.3 Installation of Valves and Hydrants

- a. Installation of Valves: Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Install gate valves on PVC water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.
- b. Installation of Hydrants: Install hydrants in accordance with AWWA C600 for hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Install hydrants with the 4 1/2 inch connections facing the adjacent paved surface. If there are two paved adjacent surfaces, contact the Contracting Officer for further instructions.

3.1.3 Installation of Water Service Piping

3.1.3.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at the points indicated; such water service lines shall be closed with plugs or caps.

3.1.3.2 Service Line Connections to Water Mains

Connect service lines 1 1/2 inch size to the main with a corporation stop and install a gate valve on service line below the frostline as indicated. Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps. Connect service lines to PVC plastic water mains in accordance with UBPPA UNI-B-8 and the recommendations of AWWA M23, Chapter 9, "Service Connections."

3.1.4 Special Requirements for Installation of Water Service Piping

3.1.4.1 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D 2774 and ASTM D 2855, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F 402.

- a. Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D 2855. Make solvent-cemented joints for ABS plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with the recommendations of the pipe manufacturer, as approved. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.
- b. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.1.5 Disinfection

Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Section 01500, "Temporary Facilities and Controls". The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in

paragraph entitled "Special Testing Requirements." Test ductile-iron water mains in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method. Test PVC plastic water mains in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in UBPPA UNI-B-3, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at plastic pipe joints .

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

-- End of Section --

SECTION 02530

SANITARY SEWERAGE
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102	(1988) Concrete Pipe Handbook
ACPA 01-103	(1990) Concrete Pipe Installation Manual

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.5.2.1M	(1981; R 1995) Metric Round Head Short Square Neck Bolts
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AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA 1-5	(1993) Pipelines
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AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME/ANSI B16.1	(1996) Cast Iron Pipe Flanges and Flanged Fittings
ASME/ANSI B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)
ANSI/ASME B18.5.2.2M	(1982; R 1993) Metric Round Head Square Neck Bolts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47M	(1990; R 1996) Ferritic Malleable Iron Castings (Metric)
ASTM A 47	(1990; R 1995) Ferritic Malleable Iron Castings
ASTM A 48M	(1994) Gray Iron Castings (Metric)
ASTM A 48	(1994; Rev. A) Gray Iron Castings

ASTM A 74	(1996) Cast Iron Soil Pipe and Fittings
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 563M	(1996) Carbon and Alloy Steel Nuts (Metric)
ASTM A 563	(1996) Carbon and Alloy Steel Nuts
ASTM A 746	(1995) Ductile Iron Gravity Sewer Pipe
ASTM C 12	(1995) Installing Vitrified Clay Pipe Lines
ASTM C 14M	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 14	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 76M	(1997) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 76	(1997) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 150	(1997; Rev. A) Portland Cement
ASTM C 361M	(1996) Reinforced Concrete Low-Head Pressure Pipe (Metric)
ASTM C 361	(1996) Reinforced Concrete Low-Head Pressure Pipe
ASTM C 425	(1997) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443M	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)
ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections

ASTM C 564	(1995; Rev. A) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 700	(1997) Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 828	(1990) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 923M	(1996) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
ASTM C 923	(1996) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 924M	(1989) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method (Metric)
ASTM C 924	(1989) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 969M	(1994) Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM C 969	(1994) Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 972	(1995) Compression-Recovery of Tape Sealant
ASTM C 990	(1996) Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C 990M	(1996) Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric)
ASTM D 412	(1997) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1784	(1997) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1996; Rev. B) Poly(Vinyl Chloride) (PVC)

	Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2235	(1996; Rev. A) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2241	(1996; Rev. B) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2321	(1989; R 1995) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	(1996; Rev. A) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2464	(1996; Rev. A) Threaded Poly(Vinyl Chloride) (PVC) Plastic Fittings, Schedule 80
ASTM D 2466	(1997) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1996; Rev. A) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2680	(1995; Rev. A) Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996; Rev. A) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1997) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3139	(1996; Rev. A) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996; Rev. A) Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals
ASTM D 4101	(1996; Rev. A) Propylene Plastic Injection and Extrusion Materials
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

ASTM F 405	(1997) Corrugated Polyethylene (PE) Tubing and Fittings
ASTM F 477	(1996; Rev. A) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 758	(1995) Smooth-Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F 794	(1997) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 949	(1996; Rev. A) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(1993) Polyethylene Encasement for Ductile - Iron Pipe Systems
AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm), for Water and Other Liquids
AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153/A21.53	(1994) Ductile-Iron Compact Fittings, 3 in. Through 24 in. (76 mm Through 610 mm) and 54 in. Through 64 in. (1,000 mm Through 1,600 mm), for Water Service
AWWA C302	(1995) Reinforced Concrete Pressure Pipe, Noncylinder Type
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C900	(1989; Addendum 1992) Polyvinyl Chloride

(PVC) Pressure Pipe, 4 in. Through 12 in.,
for Water Distribution

AWWA M9 (1995) Concrete Pressure Pipe

AWWA M23 (1980) PVC Pipe - Design and Installation

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.27 Fixed Ladders

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-60005 (1988) Frames.Covers, Gratings, Steps,
Sump and Catch Basin, Manhole

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301 (1995) Hubless Cast Iron Soil Pipe and
Fittings for Sanitary and Storm Drain,
Waste, and Vent Piping Applications

CISPI 310 (1995) Couplings Joint for Use in
Connection with Hubless Cast Iron Soil
Pipe and Fitting

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3 (1988) Installation of Polyvinyl Chloride
(PVC) Pressure Pipe

UBPPA UNI-B-6 (1990) Low-Pressure Air Testing of
Installed Sewer Pipe

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer Gravity Pipeline

Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Metal items

SD-03 Product Data

Pipeline materials including joints, fittings, and couplings

Submit manufacturer's standard drawings or catalog cuts.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

1.4.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.4.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.4.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03300, "Cast-In-Place Concrete".

1.4.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Carry, do not drag, pipe to trench.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

2.1.1 Cast-Iron Soil Piping

2.1.1.1 Cast-Iron Hub and Spigot Soil Pipe and Fittings

ASTM A 74, service, with ASTM C 564 compression-type rubber gaskets.

2.1.1.2 Cast-Iron Hubless Soil Pipe and Fittings

CISPI 301 with CISPI 310 coupling joints.

2.1.2 ABS Solid-Wall Plastic Piping

2.1.2.1 ABS Solid-Wall Plastic Pipe and Fittings

ASTM D 2751, SDR 35, with ends suitable for either solvent cement joints or elastomer joints.

2.1.2.2 ABS Solid-Wall Plastic Joints and Jointing Materials

Solvent cement for solvent cement joints shall conform to ASTM D 2235. Elastomeric joints shall conform to ASTM D 3212. Gaskets for elastomeric joints shall conform to ASTM F 477.

2.1.3 PVC Plastic Gravity Sewer Piping

2.1.3.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints.

2.1.3.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.2 CONCRETE MATERIALS

Concrete materials shall be as specified in Section 03300, "Cast-In-Place Concrete."

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

Apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

a. Sanitary piping installation parallel with water line:

(1) Normal conditions: Sanitary piping or manholes shall be laid at least 10 feet horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

(2) Unusual conditions: When local conditions prevent a horizontal separation of 10 feet, the sanitary piping or manhole may be laid closer to a water line provided that:

(a) The top (crown) of the sanitary piping shall be at least 18 inches below the bottom (invert) of the water main.

(b) Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved ductile iron water pipe pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of sanitary piping crossing a water line:

(1) Normal conditions: Lay sanitary piping crossing water lines to provide a separation of at least 18 inches between the top of the sanitary piping and the bottom of the water line whenever possible.

(2) Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sanitary piping passing over or under water lines shall be constructed of AWWA-approved ductile iron water pipe, pressure tested in place without leakage prior to backfilling.

(b) Sanitary piping passing over water lines shall, in addition, be protected by providing:

. A vertical separation of at least 18 inches between the bottom of the sanitary piping and the top of the water line.

. Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

. That the length, minimum 20 feet, of the sanitary piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.

c. Sanitary sewer manholes: No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02315, "Excavation and Fill".

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint

material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose.

3.1.1.4 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of Cast Iron Soil Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the pipe manufacturer. Make joints with the rubber gaskets specified for cast iron soil pipe joints and assemble in accordance with the recommendations of the pipe manufacturer.

3.1.2.2 Installation of ABS Solid-Wall Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make solvent cement joints with the solvent cement previously specified for this type joint. Make elastomeric joints with the gaskets specified for this type joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.3 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.4 Cleanouts

Construct cleanouts of cast iron soil pipe and fittings.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03300, "Cast-In-Place Concrete."

3.1.4 Miscellaneous Construction and Installation

3.1.4.1 Metal Work

- a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Section 01500, "Temporary Facilities and Controls".. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

- a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969.
- b. Low-pressure air tests: Perform tests as follows:

- (1) ABS composite plastic pipelines: Test in accordance with the

applicable requirements of UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

(2) PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

-- End of Section --

SECTION 02821

CHAIN LINK FENCES AND GATES

09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1995) Operating Salt Spray (Fog) Apparatus
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM F 883	(1997) Padlocks
ASTM F 1043	(1995) Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) with and Without Water for Exposure of Nonmetallic Materials
ASTM G 26	(1996) Operating Light-Exposure Apparatus (Xenon-Arc Type) with and Without Water for Exposure of Nonmetallic Materials
ASTM G 53	(1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

FEDERAL SPECIFICATIONS (FS)

FS RR-F-191	(Rev. K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories) (General Specification)
FS RR-F-191/1	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric) (Detail Specification)
FS RR-F-191/2	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Gates) (Detail Specification)
FS RR-F-191/3	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and

Braces) (Detail Specification)

FS RR-F-191/4

(Rev. D) Fencing, Wire and Post, Metal
(Chain-Link Fence Accessories) (Detail
Specification)

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Gates

Post spacing

Location of gate, corner, end, and pull posts

SD-03 Product Data

Chain-link fencing components

Accessories

SD-06 Test Reports

Weight in ounces for zinc coating

SD-08 Manufacturer's Instructions

Fence

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.4 QUALITY ASSURANCE

1.4.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding Weight in ounces for zinc coating, thickness of PVC coating, and chemical composition and thickness of aluminum alloy coating.

PART 2 PRODUCTS

2.1 CHAIN-LINK FENCING AND ACCESSORIES

FS RR-F-191 and detailed specifications as referenced and other requirements as specified.

2.1.1 Fabric

FS RR-F-191/1; Type I, zinc-coated steel, 9 gage. Mesh size, 2 inches. Provide selvage twisted and barbed at both selvages. Height of fabric, as indicated.

2.1.2 Gates

FS RR-F-191/2; Type I, single swing. Shape and size of gate frame, as indicated. Framing and bracing members, round of steel alloy. Steel member finish, zinc-coated. Gate frames and braces of minimum sizes listed in FS RR-F-191/3 for each Class and Grade except that steel pipe frames shall be 1.90 inches od, 0.120 inches minimum wall thickness and aluminum pipe frames and intermediate braces shall be 1.869 inches od, 0.940 lb/ft of length. Gate fabric, as specified for fencing fabric. Barbed wire top on gate, as specified herein. Coating for steel latches, stops, hinges, keepers, and accessories, galvanized. Gate latches, fork type. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Attach gate fabric to gate frame in accordance with manufacturer's standards, except that welding will not be permitted. Arrange padlocking latches to be accessible from both sides of gate, regardless of latching arrangement.

2.1.3 Posts and Braces

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade A or B. End, corner, and pull posts; Class 1, steel pipe, Grade A or B,. Braces ; Class 1, steel pipe, Grade A or B , in minimum sizes listed in FS RR-F-191/3 for each class and grade. Steel pipe, Class 1, Grade B shall meet the following performance criteria when subjected to salt spray testing in accordance with ASTM B 117:

- a. Exterior 1,000 hours with maximum 5 percent red rust.
- b. Interior 650 hours with maximum 5 percent red rust.

2.1.4 Fencing Accessories

FS RR-F-191/4. Provide wire ties constructed of the same material as the fencing fabric.

2.1.5 Concrete

ASTM C 94, using 3/4 inch maximum-size aggregate, and having minimum compressive strength of 3000 psi at 28 days.

2.1.6 Padlocks

ASTM F 883, with chain.

PART 3 EXECUTION

3.1 SITE PREPARATION

3.1.1 Clearing and Grading

Clear fence line of obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation. Compact fill used to establish fence line.

3.1.2 Excavation

Excavate to dimensions indicated for concrete-embedded items, except in bedrock. Clear post holes of loose material. Dispose of waste material outside limits of station.

3.2 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded areas with a repair coating matching original coating. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.2.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feet on center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.2.2 Post Setting

Set posts plumb. Allow concrete to cure a minimum of 72 hours before performing other work on posts.

3.2.2.1 Earth

Provide concrete bases of dimensions indicated. Compact concrete to eliminate voids, and finish to a dome shape.

3.2.3 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal truss rod and truss tightener used as a tension member.

3.2.4 Top and Bottom Tension Wires

Install top and bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 8 inches of respective fabric line.

3.2.5 Fabric

Pull fabric taut and secure fabric to top wire and bottom wire, close to both sides of each post and at maximum intervals of 24 inches on center. Secure fabric to posts using stretcher bars, ties or clips spaced 15 inches on center, or by integrally weaving to integral fastening loops of end, corner, pull, and gate posts for full length of each post. Install fabric on opposite side of posts from area being secured. Install fabric so that bottom of fabric is 2 inches above ground level .

3.3 ACCESSORIES INSTALLATION

3.3.1 Post Caps

Install post caps as recommended by the manufacturer.

3.3.2 Supporting Arms

Design supporting arms to accommodate top rail. Install supporting arms as recommended by manufacturer. In addition to manufacturer's standard connections, permanently secure supporting arms to posts. Studs driven by low-velocity powder-actuated tools may be used with steel, wrought iron, ductile iron, or malleable iron. Do not use studs driven by powder-actuated tools with gray iron or other material that will fracture.

3.3.3 Barbed Wire

Install barbed wire on supporting arms above fence posts. Extend each end member of gate frames sufficiently above top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence. Pull each strand taut and securely fasten each strand to each supporting arm or extended member. Secure wires in accordance with fence manufacturer's recommendations.

3.3.4 Gates

Install swing gates to swing through 180 degrees from closed to open.

3.3.5 Padlocks

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

3.4 CLEANUP

Remove waste fencing materials and other debris from the station.

-- End of Section --

SECTION 02951

PAVEMENT REMOVAL AND REPLACEMENT
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------|--|
| ASTM D 698 | (1991) Laboratory Compaction
Characteristics of Soil Using Standard
Effort (12,400 ft-lbf/ft (600 kN-m/m)) |
| ASTM D 1557 | (1991) Laboratory Compaction
Characteristics of Soil Using Modified
Effort (56,000 ft-lbf/ft (2,700 kN-m/m)) |

DISTRICT OF COLUMBIA DEPARTMENT OF TRANSPORTATION (DCDOT)

- | | |
|----------|--|
| DCDOT HS | (1974; R 1981) Highways and Structures |
|----------|--|

DEPARTMENT OF TRANSPORTATION (DOT)

- | | |
|-----------|--|
| DOT D-6.1 | (1988) Uniform Traffic Control Devices for
Streets and Highways |
|-----------|--|

FEDERAL SPECIFICATIONS (FS)

- | | |
|-------------|---|
| FS SS-S-200 | (Rev. E; Am. 2) Sealants, Joint,
Two-Component, Jet-Blast Resistant,
Cold-Applied, For Portland Cement Concrete
Pavement |
|-------------|---|

MARYLAND DEPARTMENT OF TRANSPORTATION (MDOT)

- | | |
|---------|-----------------------------------|
| MDOT CM | (1993) Construction and Materials |
|---------|-----------------------------------|

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION (NCDOT)

- | | |
|----------|-----------------------------|
| NCDOT RS | (1995) Roads and Structures |
|----------|-----------------------------|

COMMONWEALTH OF PUERTO RICO, DEPARTMENT OF TRANSPORTATION AND
PUBLIC WORKS, HIGHWAY AUTHORITY (PRHA)

- | | |
|----------|-------------------------------------|
| PRHA RBC | (1989) Road and Bridge Construction |
|----------|-------------------------------------|

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS (1994) Road and Bridge Specifications

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION (WVDT)

WVDT DHSSRB 1993 Division of Highways Standard
Specifications Road and Bridges

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-05 Design Data

Job mix formula

SD-07 Certificates

Stone Base Course

1.3 QUALITY ASSURANCE

1.3.1 Modification to References

Except as specified herein, work and materials shall be in accordance with the VDOT RBS. The provisions therein for method of measurement and payment do not apply, and references to "Engineer" and "State" shall mean the "Contracting Officer" and the "Federal Government" respectively.

1.3.2 Job Mix Formula

Submit the mix design, including mixing temperature, for approval. The bituminous mix design shall include a certified laboratory analysis of mix composition with marshall stability value, void content, and flow. After mix design approval, job mixes shall conform to the range of tolerances specified in VDOT RBS.

1.4 BARRICADES AND SIGNALS

Provide and maintain temporary signs, signals, lighting devices, markings, barricades, and channelizing and hand signaling devices to protect personnel and new construction from damage by equipment and vehicles until the surface is approved by the Contracting Officer. Work shall be conducted to permit a minimum of one traffic lane on two lane streets, and two traffic lanes on four lane streets, to be open for traffic at all times.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Bituminous Concrete

VDOT RBS, Section 211, Type SM-2A for material and mix. Provide crushed

stone aggregate for the bituminous mix.

2.1.2 Stone Base Course

VDOT RBS, Section 208, Type 1, size no. 21A, 21B, or 22.

2.1.3 Bituminous Tack Coat

VDOT RBS, Section 310. Emulsified asphalts shall be diluted at the rate of one part water to one part asphalt.

PART 3 EXECUTION

3.1 PAVEMENT INSTALLATION

The work includes the removal of existing pavement and the provision of new pavement where trenches, pits, and other excavations are made in the existing pavement. Except as otherwise indicated, the restored pavement area shall be the same kind and thickness as previously existed, and shall match and tie into the surrounding pavement in a neat and acceptable manner.

3.2 ROADS AND PARKING AREAS

3.2.1 Pavement Removal

Make a straight line sawcut 12 inches beyond the edge of the excavation to a minimum depth of 2 inches for bituminous concrete pavement. The pavement shall be broken up and removed, along with its base and subgrade, to the depth indicated or specified.

3.2.2 Subgrade Placement

Provide as specified in Section 02315, "Excavation and Fill."

3.2.3 Stone Base Placement

Provide a stone base course a minimum of 8 inches thick, unless indicated otherwise. Place the stone base in two equal lifts, with each lift compacted to 100 percent ASTM D 698 maximum density. At the Contractor's option, bituminous concrete may be provided in lieu of stone base material.

3.2.4 Bituminous Concrete Placement

Provide a tack coat on the exposed edges of the cold joints and on the bituminous concrete base when provided, and provide a minimum 2 inch thick bituminous concrete surface course, unless indicated otherwise, in accordance with VDOT RBS. Place in maximum of 2 inch lifts with each lift compacted to 96 percent of maximum laboratory density. The finished surface shall be uniform in texture and appearance and free of cracks and creases.

3.3 MATERIAL DISPOSAL

Pavement, base, and subgrade materials that have been excavated shall be

disposed of off Government property.

-- End of Section --

SECTION 03300

CAST-IN-PLACE CONCRETE
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M182 (1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117 (1990) Tolerances for Concrete
Construction and Materials

ACI 211.1 (1991) Selecting Proportions for Normal,
Heavyweight, and Mass Concrete

ACI 211.2 (1991) Selecting Proportions for
Structural Lightweight Concrete

ACI 213R (1987) Structural Lightweight Aggregate
Concrete

ACI 301 (1996) Structural Concrete

ACI 302.1R (1996) Concrete Floor and Slab Construction

ACI 304R (1989) Measuring, Mixing, Transporting,
and Placing Concrete

ACI 304.2R (1996) Placing Concrete by Pumping Methods

ACI 305R (1991) Hot Weather Concreting

ACI 306.1 (1990) Cold Weather Concreting

ACI 315 (1994) Details and Detailing of Concrete
Reinforcement

ACI 318/318M (1995) Building Code Requirements for
Structural Concrete

ACI 347R (1994) Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82 (1997) Steel Wire, Plain, for Concrete Reinforcement

ASTM A 123/A 123M (1997; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 185 (1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

ASTM A 496 (1997) Steel Wire, Deformed, for Concrete Reinforcement

ASTM A 497 (1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement

ASTM A 615/A 615M (1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A 616/A 616M (1996; Rev. A) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A 617/A 617M (1996; Rev. A) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A 706/A 706M (1996; Rev. B) Low-Alloy Steel Deformed Bars for Concrete Reinforcement

ASTM A 767/A 767M (1997) Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

ASTM A 775/A 775M (1997) Epoxy-Coated Reinforcing Steel Bars

ASTM A 780 (1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

ASTM A 934/A 934M (1997) Epoxy-Coated Prefabricated Steel Reinforcing Bars

ASTM C 31/C 31M (1996) Making and Curing Concrete Test Specimens in the Field

ASTM C 33 (1997) Concrete Aggregates

ASTM C 39 (1996) Compressive Strength of Cylindrical Concrete Specimens

ASTM C 42	(1994) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 143	(1990; Rev. A) Slump of Hydraulic Cement Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 171	(1997) Sheet Materials for Curing Concrete
ASTM C 172	(1997) Sampling Freshly Mixed Concrete
ASTM C 173	(1994; Rev. A) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(1995) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 227	(1990) Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 295	(1990) Petrographic Examination of Aggregates for Concrete
ASTM C 309	(1997) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 330	(1989) Lightweight Aggregates for Structural Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 567	(1991) Unit Weight of Structural Concrete
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)
ASTM C 595	(1994; Rev. A) Blended Hydraulic Cements
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 881	(1990) Epoxy-Resin-Base Bonding Systems for Concrete

ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1017	(1992) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1107	(1997) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1116	(1995) Fiber-Reinforced Concrete and Shotcrete
ASTM C 1240	(1997) Silica Fume for Use in Hydraulic-Cement Concrete and Mortar
ASTM D 1190	(1996) Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1854	(1996) Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 1155/E 1155M	(1996) Determining Floor Flatness and Levelness Using the F-Number System

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4	(1998) Structural Welding Code - Reinforcing Steel
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CORPS OF ENGINEERS (COE)

COE CRD-C-572	(1974) Polyvinylchloride Waterstop
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U.S. DEPARTMENT OF COMMERCE PRODUCT STANDARDS (PS)

PS-1	(1995) Construction and Industrial Plywood
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FEDERAL SPECIFICATIONS (FS)

FS SS-S-200 (Rev. E; Am. 2) Sealants, Joint,
Two-Component, Jet-Blast Resistant,
Cold-Applied, For Portland Cement Concrete
Pavement

FS UU-B-790 (Rev. A Reinst) Building Paper, Vegetable
Fiber: (Kraft, Waterproofed, Water
Repellent and Fire Resistant)

FS SS-S-1614 (Rev. A) Sealants, Joint,
Jet-Fuel-Resistant, Hot-Applied, for
Portland Cement and Tar Concrete Pavements

US DEPARTMENT OF TRANSPORTATION V DOT

V DOT RBS 1996 Road and Bridge Specifications

1.2 DEFINITIONS

- a. "Cementitious material" as used herein shall include all portland cement, pozzolan, fly ash, ground iron blast-furnace slag, and silica fume.
- b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Reinforcing steel; G

Reproductions of contract drawings are unacceptable.

SD-03 Product Data

Materials for curing concrete

Joint sealants

Joint filler

Vapor barrier

SD-05 Design Data

Concrete mix design; G

Thirty days minimum prior to concrete placement, submit a mix

design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, ground slag, and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. No material shall be provided unless proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. The submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. An identical concrete mix design previously approved within the past 12 months by the Atlantic Division, Naval Facilities Engineering Command, Code 406, 1510 Gilbert Street, Norfolk, Va. 23511, as an annual mix design submittal, may be used without further approval when accompanied by a letter signed by an authorized representative of the concrete supplier indicating the mix number, cement type, water-cement ratio, slump, maximum nominal aggregate size, admixtures, percentage of air entrainment, and a statement that the materials to be used are on the list of approved certifications. In addition, copies of the fly ash, and pozzolan test results shall be submitted. The approval of fly ash, and pozzolan tests results shall have been within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

SD-06 Test Reports

Concrete mix design; G

Fly ash

Pozzolan

Ground iron blast-furnace slag

Compressive strength tests

Unit weight of structural lightweight concrete

Ion Concentration

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI 301 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 Quality Assurance

1.6.1 Drawings

1.6.1.1 Reinforcing Steel

ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.6.2 Test Reports

1.6.2.1 Concrete Mix Design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include mill test and all other test for cement, aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Test reports shall be submitted along with the concrete mix design. Obtain approval before concrete placement.

1.6.2.2 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C 618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date.

1.6.2.3 Ground Iron Blast-Furnace Slag

Submit test results in accordance with ASTM C 989 for ground iron blast-furnace slag. Submit test results performed within 6 months of submittal date.

PART 2 PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, or steel. Use plywood or steel forms where a smooth form finish is required. Lumber shall be square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects.

Plywood: PS-1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Steel form surfaces shall not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES

The use of wire alone is prohibited. Form ties and accessories shall not reduce the effective cover of the reinforcement.

2.3 CONCRETE

2.3.1 Contractor-Furnished Mix Design

ACI 211.1, ACI 301, and ACI 318/318M and ACI 211.2 and ACI 213R except as otherwise specified. The compressive strength (f'_c) of the concrete for each portion of the structure(s) shall be as indicated and as specified below.

Location	f'_c (Min. 28- Day Comp. Strength) (psi)	ASTM C 33 Maximum Nominal Aggregate (Size No.)	Range of Slump (inches)	Maximum Water- Cement Ratio (by weight)	Air Entr. (percent)
All areas	3500	57	2-4	0.48	5-7

Maximum slump shown above may be increased one inch for methods of consolidation other than vibration. Slump may be increased to 8 inches when superplasticizers are used. Provide air entrainment using air-entraining admixture. Air entrainment shall be within plus or minus 1.5 percent of the value specified. The water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days shall not exceed 0.15.

2.3.1.1 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1. The trial mixture shall use at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and

type of concrete required on the project. The maximum water-cement ratio required will be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast-furnace slag by weight equivalency method. Laboratory trial mixture shall be designed for maximum permitted slump and air content. Each combination of material proposed for use shall have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39 for 7 and 28 days. From these results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition a curve shall be plotted showing the relationship between 7 and 28 day strengths.

2.3.1.2 Lightweight Concrete Proportion

ACI 211.2, using weight method. Provide ASTM C 330 aggregates for concrete; 115 pcf (dry) for floors with a 3000 psi minimum compressive strength at 28 days. Provide aggregate size No. . . Range of slump shall be between 4 and 5 inches. Provide 2 percent air entrainment using an air-entraining admixture. Maximum water-cement ratio shall be 0.50.

2.3.1.3 Required Average Strength of Mix Design

The selected mixture shall produce an average compressive strength exceeding the specified strength by the amount indicated in ACI 301. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation shall be calculated and the required average compressive strength shall be determined in accordance with ACI 301. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength shall be as follows:

- a. For f'_c between 3000 and 5000 psi, 1200 psi plus f'_c .

2.4 MATERIALS

2.4.1 Cement

ASTM C 150, Type I or II or ASTM C 595, Type IP(MS) or IS(MS) blended cement except as modified herein. The blended cement shall consist of a mixture of ASTM C 150, Type II, cement and one of the following materials: ASTM C 618 pozzolan or fly ash, ASTM C 989 ground iron blast-furnace slag. The pozzolan or fly ash content shall not exceed 25 percent by weight of the total cementitious material. The ground iron blast-furnace slag shall not exceed 50 percent by weight of total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.4.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on

ignition shall be 6 percent for Types N and F. Add with cement.

2.4.1.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 120.

2.4.2 Water

Water shall be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.4.3 Aggregates

ASTM C 33, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalis in the cement.

2.4.3.1 Aggregates for Lightweight Concrete

ASTM C 330.

2.4.4 Nonshrink Grout

ASTM C 1107.

2.4.5 Admixtures

ASTM C 494: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures.

2.4.5.1 Air-Entraining

ASTM C 260.

2.4.5.2 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494, Type F and ASTM C 1017.

2.4.6 Vapor Barrier

ASTM D 4397 polyethylene sheeting, minimum 6 mil thickness.

2.4.6.1 Polyethylene Sheeting

ASTM D 4397, minimum 6 mil thickness.

2.4.7 Materials for Curing Concrete

2.4.7.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.4.7.2 Pervious Sheeting

AASHTO M182.

2.4.7.3 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B.

2.4.8 Expansion/Contraction Joint Filler

ASTM D 1751 or ASTM D 1752, 1/2 inch thick, unless otherwise indicated.

2.4.9 Joint Sealants

2.4.9.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 1190 or ASTM C 920, Type M, Class 25, Use T. ASTM D 1854 for surfaces subjected to jet fuel.

2.4.9.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C 920, Type M, Grade NS, Class 25, Use T.

2.5 REINFORCEMENT

Bars, fabrics, connectors, and chairs shall be galvanized.

2.5.1 Reinforcing Bars

ACI 301 unless otherwise specified. ASTM A 615/A 615M and ASTM A 617/A 617M with the bars marked A, S, W, Grade 60 ; or ASTM A 616/A 616M with the bars marked R, Grade 60 .

2.5.2 Mechanical Reinforcing Bar Connectors

ACI 301. Provide 125 percent minimum yield strength of the reinforcement bar.

2.5.3 Welded Wire Fabric

ASTM A 185 or ASTM A 497. Provide flat sheets of welded wire fabric for slabs and toppings.

2.5.4 Wire

ASTM A 82 or ASTM A 496.

2.5.5 Reinforcing Bar Supports

Provide bar ties and supports of coated or non corrodible material.

PART 3 EXECUTION

3.1 FORMS

ACI 301. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water shall be watertight.

3.1.1 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.1.2 Removal of Forms and Supports

After placing concrete, forms shall remain in place for the time periods specified in ACI 347R. Prevent concrete damage during form removal.

3.1.2.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39 test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.2 Formed Surfaces

3.2.1 Tolerances

ACI 347R and as indicated.

3.2.2 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used.

3.3 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement shall not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.3.1 Vapor Barrier

Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches. Remove torn, punctured, or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete. Concrete placement shall not damage vapor barrier material.

3.3.2 Reinforcement Supports

Place reinforcement and secure with galvanized or non corrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other non corrodible material, having a compressive strength equal to or greater than the concrete being placed.

3.3.3 Splicing

As indicated. For splices not indicated ACI 301. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches.

3.3.4 Cover

ACI 301 for minimum coverage, unless otherwise indicated.

3.3.5 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.3.6 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

3.3.7 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Sawed joints shall be completed within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.4 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C 94, ACI 301, ACI 302.1R, and ACI 304R, except as modified herein. Batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.4.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.4.2 Mixing

ASTM C 94 and ACI 301. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 85 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.4.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.5 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs.

3.5.1 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width shall be a minimum of 4 inches greater than indicated.

3.5.2 Vibration

ACI 301. Furnish a spare vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 18 inches apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 18 inch maximum vertical lifts. External vibrators shall be used on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.5.3 Pumping

ACI 304R and ACI 304.2R. Pumping shall not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment shall not exceed 2 inches. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy. Rapid changes in pipe sizes shall be avoided. Maximum size of course aggregate shall be limited to 33 percent of the diameter of the pipe. Maximum size of well rounded aggregate shall be limited to 40 percent of the pipe diameter. Samples for testing shall be taken at both the point of delivery to the pump and at the discharge end.

3.5.3.1 Pumping Lightweight Concrete

ACI 213R. Aggregates shall be presoaked or presaturated. Cement content shall be minimum of 564 pounds per cubic yard and shall be sufficient to accommodate a 4 to 6 inch slump. Field trial run shall be made in accordance with ACI 213R.

3.5.4 Cold Weather

ACI 306.1. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 5 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.5.5 Hot Weather

ACI 305R. Maintain required concrete temperature using Figure 2.1.5 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide

water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.6 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.6.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 347R. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.6.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified shall be finished with wood floats to even surfaces. Finish shall match adjacent finishes.

3.6.3 Formed Surfaces

3.6.3.1 Tolerances

ACI 117 and as indicated.

3.6.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch this holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.7 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI 302.1R, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Where straightedge measurements are specified, Contractor shall provide straightedge.

3.7.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous

materials. Do not use dry cement to absorb bleedwater.

3.7.1.1 Floated

Use for exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float shall begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, surface shall be checked with a 10 foot straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. High spots shall be cut down and low spots filled during this procedure to produce a surface level within 1/4 inch in 10 feet.

3.7.1.2 Steel Troweled

Use for floors intended as walking surfaces. First, provide a floated finish. The finish shall next be power troweled two times, and finally hand troweled. The first troweling after floating shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Additional trowelings shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be essentially free of trowel marks and uniform in texture and appearance. The finished surface shall produce a surface level to within 1/4 inch in 10 feet. On surfaces intended to support floor coverings, any defects of sufficient magnitude to show through the floor covering shall be removed by grinding.

3.7.1.3 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.7.2 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints one inch deep with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish.

Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.7.3 Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum unless otherwise

indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.8 CURING AND PROTECTION

ACI 301 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating.

3.8.1 Moist Curing

Remove water without erosion or damage to the structure.

3.8.1.1 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.8.2 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI 305R indicates that hot weather conditions will cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

3.8.2.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the

two coats shall be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Re-spray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.8.2.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.8.3 Curing Periods

ACI 301 except 10 days for retaining walls, pavement or chimneys, 21 days for concrete that will be in full-time or intermittent contact with seawater, salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval by the Contracting Officer.

3.9 FIELD QUALITY CONTROL

3.9.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.9.2 Testing

3.9.2.1 Slump Tests

ASTM C 143. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.9.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.9.2.3 Compressive Strength Tests

ASTM C 39. Make five test cylinders for each set of tests in accordance with ASTM C 31/C 31M. Precautions shall be taken to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two

cylinders at 28 days, and hold one cylinder in reserve. Samples for strength tests of each mix design of concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 5000 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'_c or if any strength test result falls below f'_c by more than 500 psi, take a minimum of three ASTM C 42 core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test shall be considered structurally adequate if the average of three cores is equal to at least 85 percent of f'_c and if no single core is less than 75 percent of f'_c . Locations represented by erratic core strengths shall be retested. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.9.2.4 Air Content

ASTM C 173 or ASTM C 231 for normal weight concrete and ASTM C 173 for lightweight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.9.2.5 Unit Weight of Structural Lightweight Concrete

ASTM C 567. Determine unit weight of lightweight concrete. Perform test for every 20 cubic yards maximum.

3.9.2.6 Ion Concentration

ACI 318/318M. Determine water soluble ion concentration. Perform test once for each mix design.

-- End of Section --

SECTION 03410

PLANT-PRECAST STRUCTURAL CONCRETE
03/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO SSHB-I-14 Highway Bridges-Division I-Section 14:
Bearings

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 304R (1989) Measuring, Mixing, Transporting,
and Placing Concrete

ACI 305R (1991) Hot Weather Concreting

ACI 306.1 (1990) Cold Weather Concreting

ACI 309R (1996) Consolidation of Concrete

ACI 318/318M (1995) Building Code Requirements for
Structural Concrete

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A135.4 (1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 27/A 27M (1995) Steel Castings, Carbon, for General
Application

ASTM A 36/A 36M (1996) Carbon Structural Steel

ASTM A 47M (1990) Ferritic Malleable Iron Castings
(Metric)

ASTM A 47 (1990) Ferritic Malleable Iron Castings

ASTM A 123/A 123M (1997; Rev. A) Zinc (Hot-Dip Galvanized)
Coatings on Iron and Steel Products

ASTM A 153/A 153M (1995) Zinc Coating (Hot-Dip) on Iron and

Steel Hardware

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 325	(1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 497	(1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 563M	(1996) Carbon and Alloy Steel Nuts (Metric)
ASTM A 563	(1996) Carbon and Alloy Steel Nuts
ASTM A 615/A 615M	(1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996; Rev. A) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1996; Rev. A) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 706/A 706M	(1996; Rev. B) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C 33	(1997) Concrete Aggregates
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 330	(1989) Lightweight Aggregates for Structural Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)

ASTM C 595	(1994; Rev. A) Blended Hydraulic Cements
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1107	(1997) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 436	(1993) Hardened Steel Washers
ASTM F 844	(1990) Washers, Steel, Plain (Flat), Unhardened for General Use

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4	(1998) Structural Welding Code - Reinforcing Steel
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PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1985) Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI MNL-120	(1992) Design Handbook - Precast and Prestressed Concrete
PCI MNL-124	(1989) Fire Resistance of Precast Prestressed Concrete

UNDERWRITERS LABORATORIES INC. (UL)

UL FRD	(1997) Fire Resistance Directory
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1.2 PRECAST MEMBERS

The work includes the provision of precast non-prestressed concrete herein referred to as precast members. Precast members shall be the product of a manufacturer specializing in the production of precast concrete members. In the ACI publications, the advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears; reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" shall be interpreted to mean the Contracting Officer.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Drawings of precast members; G

SD-03 Product Data

Anchorage and lifting inserts and devices

Bearing pads

SD-04 Samples

Surface Finish

SD-05 Design Data

Precast concrete members design calculations; G

Concrete mix design

SD-06 Test Reports

Contractor-furnished mix design

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval before concrete placement.

SD-07 Certificates

Fabrication

Submit quality control procedures established in accordance with PCI MNL-116 by the precast manufacturer.

SD-11 Closeout Submittals

Concrete batch ticket information

1.4 QUALITY CONTROL

1.4.1 Precast Concrete Member Design

ACI 318/318M and the PCI MNL-120. Design precast members (including connections) for the design load conditions and spans indicated, and for additional loads imposed by openings and supports of the work of other trades. Design precast members for handling without cracking in accordance with the PCI MNL-120. Concrete toppings shall not be used in establishing the design strength of the precast members.

1.4.2 PCI Quality Certifications

PCI MNL-116. At the precast manufacturer's option, in lieu of core samples, ACI 318/318M, full scale load tests may be performed. Perform on randomly selected members, as directed by the Contracting Officer.

1.4.2.1 Product Quality Control

Plants shall be certified by the PCI Plant Certification Program for Category C2 work.

1.5 DELIVERY AND STORAGE

Lift and support precast members at the lifting and supporting points indicated on the shop drawings. Store precast members off the ground. Separate stacked precast members by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload.

1.6 FACTORY INSPECTION

At the option of the Contracting Officer, precast units shall be inspected by the QC Representative prior to being transported to the job site. The Contractor shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.7 QUALITY ASSURANCE

1.7.1 Drawing Information

Submit drawings indicating complete information for the fabrication, handling, and erection of the precast member. Drawings shall not be reproductions of contract drawings. Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:

- a. Marking of members for erection
- b. Connections for work of other trades
- c. Connections between members, and connections between members and other construction
- d. Location and size of openings
- e. Headers for openings
- f. Joints between members, and joints between members and other construction
- g. Reinforcing details

- h. Material properties of steel and concrete used
- i. Lifting and erection inserts
- j. Dimensions and surface finishes of each member
- k. Erection sequence and handling requirements
- l. All loads used in design (such as live, dead, handling, and erection)
- m. Bracing/shoring required
- n. Areas to receive toppings, topping thickness.

1.7.2 Design Calculations

Submit calculations reflecting design conforming to requirements of paragraph entitled "Precast Concrete Member Design." Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication.

1.7.3 Concrete Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Include a complete list of materials including type; brand; source and amount of cement, pozzolan, and admixtures; and applicable reference specifications.

1.7.4 Certificates: Record Requirement

ASTM C 94. Submit mandatory batch ticket information for each load of ready-mixed concrete.

PART 2 PRODUCTS

2.1 CONTRACTOR-FURNISHED MIX DESIGN

ACI 318/318M. The minimum compressive strength of concrete at 28 days shall be 5000 psi, unless otherwise indicated.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type I, II, or III; or ASTM C 595 Type IP(MS) or IS(MS) blended cement, except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and one of the following materials: ASTM C 618 pozzolan or fly ash, or ASTM C 989 ground iron blast furnace slag. The pozzolan/fly ash content shall not exceed 25 percent by weight of the total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Type N and F.

2.2.1.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 100 or 120.

2.2.2 Water

Water shall be fresh, clean, and potable.

2.2.3 Aggregates

2.2.3.1 Aggregates Selection

ASTM C 33, Size 67, except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.2.4 Grout

2.2.4.1 Nonshrink Grout

ASTM C 1107.

2.2.4.2 Cementitious Grout

Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method.

2.2.5 Admixtures

2.2.5.1 Accelerating

ASTM C 494, Type C or E.

2.2.5.2 Water Reducing

ASTM C 494, Type A, E, or F.

2.2.6 Reinforcement

2.2.6.1 Reinforcing Bars

ASTM A 615/A 615M, Grade 60 ; ASTM A 617/A 617M, Grade 60 ; or ASTM A 616/A 616M, Grade 60 .

2.2.6.2 Welded Wire Fabric

ASTM A 185 or ASTM A 497.

2.2.7 Metal Accessories

Provide ASTM A 123/A 123M or ASTM A 153/A 153M galvanized.

2.2.7.1 Inserts

ASTM A 47, Grade 32510 or 35018, or ASTM A 27/A 27M Grade U-60-30.

2.2.7.2 Structural Steel

ASTM A 36/A 36M.

2.2.7.3 Bolts

ASTM A 307; ASTM A 325.

2.2.7.4 Nuts

ASTM A 563.

2.2.7.5 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436 washers for ASTM A 325 bolts.

2.2.8 Bearing Pads

2.2.8.1 Hardboard (Interior Only)

ANSI A135.4, class as specified by the precast manufacturer.

2.3 FABRICATION

PCI MNL-116 unless specified otherwise.

2.3.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 3/4 inch, unless otherwise indicated. Provide threaded or snap-off type form ties.

2.3.2 Reinforcement Placement

ACI 318/318M for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between precast and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections.

2.3.3 Concrete

2.3.3.1 Concrete Mixing

ASTM C 94. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

2.3.3.2 Concrete Placing

ACI 304R, ACI 306.1 for cold weather concreting, and ACI 309R, unless otherwise specified.

2.3.3.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 50 and 190 degrees F. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts.

2.3.4 Surface Finish

Repairs located in a bearing area shall be approved by the Contracting Officer prior to repairs. Precast members containing hairline cracks which are visible and are less than 0.02 inches in width, may be accepted, except that cracks larger than 0.005 inches in width for surfaces exposed to the weather shall be repaired. Precast members which contain cracks greater than 0.02 inches in width shall be approved by the Contracting Officer, prior to being repaired. Any precast member that is structurally impaired or contains honeycombed section deep enough to expose reinforcing shall be rejected.

2.3.4.1 Unformed Surfaces

Provide a floated finish.

2.3.4.2 Formed Surfaces

PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes.

- a. Unexposed Surfaces: Provide a standard grade surface finish.
- b. Exposed Surfaces: Provide a finish Grade B surface finish. The combined area of acceptable defective areas shall not exceed 0.2 percent of the exposed to view surface area, and the patches shall be indistinguishable from the surrounding surfaces when dry.

PART 3 EXECUTION

3.1 SURFACE REPAIR

Prior to erection, and again after installation, precast members shall be checked for damage, such as cracking, spalling, and honeycombing. As directed by the Contracting Officer, precast members that do not meet the surface finish requirements specified in Part 2 in paragraph entitled "Surface Finish" shall be repaired, or removed and replaced with new

precast members.

3.2 ERECTION

Precast members shall be erected after the concrete has attained the specified compressive strength, unless otherwise approved by the precast manufacturer. Erect in accordance with the approved shop drawings. PCI MNL-116 and PCI MNL-120 (Chapter 8), for tolerances. Brace precast members, unless design calculations submitted with the shop drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place precast members level, plumb, square, and true within tolerances. Align member ends.

3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the precast member and adjacent precast members or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Do not use hardboard bearing pads in exterior locations. Place precast members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

3.4 ANCHORAGE

Provide anchorage for fastening work in place. Conceal fasteners where practicable. Make threaded connections up tight and nick threads to prevent loosening.

3.5 WELDING

AWS D1.4 for welding connections and reinforcing splices. Protect the concrete and other reinforcing from heat during welding. Weld continuously along the entire area of contact. Grind smooth visible welds in the finished installation. Welding of epoxy-coated reinforcing is not allowed.

3.6 OPENINGS

Holes or cuts requiring reinforcing to be cut, which are not indicated on the approved shop drawing, shall only be made with the approval of the Contracting Officer and the precast manufacturer. Drill holes less than 12 inches in diameter with a diamond tipped core drill.

3.7 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanized surfaces damaged by handling, transporting, cutting, welding, bolting, or acid washing. Do not heat surfaces to which repair paint has been applied.

3.8 GROUTING

Clean and fill keyways between precast members, and other indicated areas,

solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

3.9 SEALANTS

Provide as indicated and as specified in Section 07920, "Joint Sealants."

3.10 CONCRETE TOPPING

Provide as indicated and as specified in Section 03300, "Cast-In-Place Concrete."

-- End of Section --

SECTION 04200

UNIT MASONRY
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318/318M (1995) Building Code Requirements for Structural Concrete

ACI 530.1 (1995) Masonry Structures (ASCE 6-95)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82 (1997) Steel Wire, Plain, for Concrete Reinforcement

ASTM A 90/A 90M (1995; Rev. A) Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

ASTM A 153/A 153M (1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 167 (1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A 615/A 615M (1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A 616/A 616M (1996; Rev. A) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM B 370 (1992) Copper Sheet and Strip for Building Construction

ASTM C 27 (1993) Fireclay and High-Alumina Refractory Brick

ASTM C 55 (1997) Concrete Building Brick

ASTM C 62 (1997) Building Brick (Solid Masonry Units Made from Clay or Shale)

ASTM C 67	(1997) Sampling and Testing Brick and Structural Clay Tile
ASTM C 73	(1997; Rev. A) Calcium Silicate Face Brick (Sand-Lime Brick)
ASTM C 90	(1997) Loadbearing Concrete Masonry Units
ASTM C 91	(1997) Masonry Cement
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 129	(1997) Nonloadbearing Concrete Masonry Units
ASTM C 144	(1997) Aggregate for Masonry Mortar
ASTM C 150	(1997) Portland Cement
ASTM C 207	(1991; R 1992) Hydrated Lime for Masonry Purposes
ASTM C 216	(1997) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(1997) Mortar for Unit Masonry
ASTM C 315	(1996) Clay Flue Linings
ASTM C 476	(1995) Grout for Masonry
ASTM C 652	(1997) Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
ASTM C 744	(1997) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	(1996) Preconstruction and Construction Evaluations of Mortars for Plain and Reinforced Unit Masonry
ASTM C 1019	(1989; Rev. A, R 1993) Sampling and Testing Grout
ASTM C 1072	(1994) Measurement of Masonry Flexural Bond Strength
ASTM C 1142	(1995) Extended Life Mortar for Unit Masonry
ASTM D 1330	(1985; R 1995) Rubber Sheet Gaskets
ASTM E 447	(1997) Compressive Strength of Laboratory

Constructed Masonry Prisms

ASTM E 514

(1990; R 1996) Water Penetration and
Leakage Through Masonry

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC

(1994) Uniform Building Code

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Reinforcing steel

Movement joints

SD-03 Product Data

Masonry accessories

Reinforcement

Control joints

Water-repellant admixture

Flashing

Submit for each type.

SD-04 Samples

Masonry units; G

Mortar color; G

Submit two sets of each type masonry units, showing full range of color, texture, finish, and dimensions and two samples of each color of mortar.

Masonry panel; G

SD-06 Test Reports

Unit strength method

Mortar properties

Grout

Efflorescence test

Submit efflorescence test reports on masonry units that are to be exposed to weathering.

Grout strength

Mortar strength and properties

SD-07 Certificates

Concrete masonry units

Building brick

Facing brick

Water-repellant admixture

Certify that the additive does not adversely offset bond strength as tested under ASTM C 1072.

SD-08 Manufacturer's Instructions

Masonry cement

When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

1.3 QUALITY ASSURANCE

1.3.1 Appearance

Do not change source or supply of materials after brick manufacturing work has started. Bricks shall be manufactured at one time and from the same batch. Blend all brick to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable.

1.3.2 Testing

Masonry strength shall be determined in accordance with ACI 530.1 and the cost of testing shall be paid by the Contractor.

1.3.3 Drawing Requirements

Indicate splicing, laps, shapes, dimensions, and details of movement joints, reinforcing steel, and accessories. Include details of anchors, adjustable wall ties, positioning devices, bond beams, and lintels. Do not scale drawings to determine lengths of bars.

1.3.4 Field Samples: Masonry Panel Requirements

At the job site submit for approval by the Contracting Officer, a sample masonry panel approximately 4 feet long by 4 feet high showing the workmanship, coursing, bond, weep holes, flashing, thickness, anchors, joint reinforcing, wall ties, rigid-board insulation, and tooling of joints, range of color, texture of masonry, and mortar color, masonry ties and anchors, and tooling of joints, the range of color and texture of brick veneer, and the color of mortar. The sample panel be constructed in place as a corner of the building. The approved panel shall be part of the finish construction.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver cementitious materials to the site in unbroken containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious materials in dry, weathertight sheds or enclosures and handle so as to prevent entry of foreign materials and damage by water or dampness. Store masonry units off the ground and handle with care to avoid chipping and breakage. Protect materials from damage and, except for sand, keep dry until used. Cover sand to prevent intrusion of water and foreign materials and to prevent drying. Do not use materials containing frost or ice. Store Type II, concrete masonry units at the site for a minimum of 28 days for air cured units, 10 days for atmospheric steam or water cured units, and 3 days for units cured with steam at a pressure of 120 to 150 psi and at a temperature of 350 to 365 degrees F for at least 5 hours. Protect moisture controlled units (Type I) from rain and ground water.

1.5 ENVIRONMENTAL CONDITIONS

1.5.1 Hot Weather Construction

ACI 530.1.

1.5.2 Cold Weather Construction

ACI 530.1.

1.6 SCHEDULING

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching.

1.7 BRACING

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

PART 2 PRODUCTS

2.1 MASONRY UNITS

2.1.1 Building Brick

ASTM C 62; Grade SW for vertical surfaces in contact with the earth,

exposed vertical surfaces in the severe weathering region, as defined in ASTM C 62, and for all non vertical surfaces; Grade SW or MW for other locations. Average dimensions of brick shall be 3 5/8 inches thick, 2 1/4 inches high, and 8 inches long (standard), or 4 inches thick, 2 2/3 inches high, and 8 inches long (nominal), subject to the tolerances specified in ASTM C 62.

2.1.2 Facing Brick

2.1.2.1 Solid Brick

ASTM C 216, Grade SW, Type FBS, 3 5/8 inches thick, 2 1/4 inches high, and 8 inches long (nominal) . Color, texture, and range of facing brick shall match the brick indicated.

ASTM C 216, Grade SW, Type FBS, with light buff color and wire cut texture to match the color and texture of the control buildings below, nominal 2 1/4 by 3 5/8 or 3 1/2 by 12 inches (nominal). Brick shall not be lighter in color than the lightest brick on the control buildings listed below. Brick shall be manufactured at one time and stockpiled before beginning shipments to the job site. At the Contractor's option, 2 1/4 by 3 5/8 or 3 1/2 by 8 inches (nominal) long facing brick may be provided.

2.1.2.2 Hollow Brick

ASTM C 652, Grade SW , Type HBS , Class H40V . Nominal size 3 5/8 inches thick, 2 1/4 inches high and 8 inches long. Color and texture shall be as indicated.

2.1.3 Concrete Masonry Units

Units of modular dimensions and air, water, or steam cured. Exposed surfaces of units shall be smooth and of uniform texture.

- a. Hollow Load-Bearing Units: ASTM C 90, Type I or II, made with normal weight aggregate. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.
- b. Hollow Non-Load-Bearing Units: ASTM C 129, Type I or II, made with normal weight aggregate. Load-bearing units may be provided in lieu of non-load-bearing units.
- c. Concrete Building Brick: ASTM C 55, Type I or II, Grade S, normal weight units, except brick exposed to weather shall be Grade N. Concrete brick shall match the concrete masonry units in color and surface characteristics.
- d. Solid Load-Bearing Units: ASTM C 90, Type I or II, normal weight units. Provide solid units as indicated.

2.1.4 Water-Repellant Admixture

Polymeric type formulated to reduce porosity and water transmission. Construct panels of masonry units conforming to ASTM C 744 and mortar which

contain the water-repellant admixture. When tested in accordance with ASTM C 1072, such panels shall have flexural strength not less than that specified or indicated. When tested in accordance with ASTM E 514, panels shall exhibit no water visible on back of test panel and no leaks through the panel after 24 hours, and not more than 25 percent of wall area shall be damp after 72 hours.

2.2 MORTAR

2.2.1 Mortar Properties

ASTM C 270, Type M for foundation walls; Type N or S for non-load-bearing, non-shear-wall interior masonry; and Type S for remaining masonry work; except where higher compressive strength is indicated on structural drawings. Where colored mortar is indicated, add pigment to obtain the mortar color indicated. The quantity of metallic oxide pigment relative to the cementitious content of the mortar mix shall be no more than 10 percent by weight. Carbon black shall be no more than 2 percent by weight.

2.2.1.1 Portland Cement

ASTM C 150, Type I, IA, or IIA,.

2.2.1.2 Hydrated Lime

ASTM C 207, Type S.

2.2.1.3 Masonry Cement

ASTM C 91, Type S . Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

2.2.1.4 Sand

ASTM C 144.

2.2.1.5 Water

Clean, potable, and free from substances which could adversely affect the mortar.

2.3 GROUT

ASTM C 476, fine . Slump between 8 and 11 inches. Provide minimum grout strength of 2000 psi in 28 days, as tested by ASTM C 1019.

2.3.1 Admixtures

Do not use air-entrainment, anti-freeze, or chloride admixtures.

2.3.2 Ready-Mixed Grout

ASTM C 94.

2.4 MASONRY ACCESSORIES

2.4.1 Horizontal Joint Reinforcement

Fabricate from cold drawn steel wire, ASTM A 82. Wire shall be hot-dipped galvanized after fabrication in accordance with ASTM A 153/A 153M, Class B-2, 1.5 ounces of zinc per square foot. Reinforcement shall be truss type with two or more longitudinal wires welded to a continuous diagonal cross wire, or ladder type with perpendicular cross wires not more than 16 inches o.c. Provide flat sections 10 feet long, and preformed corners and tees approximately 30 inches long. Overall width shall be approximately 2 inches less than nominal thickness of wall.

2.4.1.1 Single-Wythe

For single-wythe walls and partitions, provide two 9 gage 0.1483 inch longitudinal wires and 9 gage cross wires.

2.4.1.2 Brick-Faced or Composition Walls

For brick-faced or composition walls, provide three 9 gage 0.1483 inch longitudinal wires, one for each face shell of concrete masonry units and one for the brick wythe, and 9 gage cross wires.

2.4.1.3 Cavity Walls

For cavity walls, provide truss type reinforcing utilizing three 9 gage 0.1483 inch longitudinal wires, one for each face shell of concrete masonry units and one for the brick wythe, and 9 gage cross wires.

2.4.2 Fastenings

Build in bolts, metal wall plugs, and other metal fastenings furnished under other sections for securing furring and other items.

2.4.3 Reinforcing Bars

ASTM A 615/A 615M or ASTM A 616/A 616M.

2.4.3.1 Fabrication

ACI 530.1.

2.4.3.2 Bar Positioners

Provide positioners that prevent displacement of reinforcing during construction.

2.4.4 Through-Wall Flashing

Provide the following type:

- a. Stainless Steel Flashing: stainless steel, ASTM A 167, Type 301, 302, 304, or 316, 0.015 inch thick, No. 2D finish. Provide with

factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.

2.4.5 Weep Holes

Prefabricated aluminum, or plastic sized to form the proper size opening in head joints. Provide aluminum and plastic inserts with grill or screen-type openings designed to allow the passage of moisture from cavities and to prevent the entrance of insects.

2.4.6 Sealant

Sealant as specified in Section 07920, "Joint Sealants."

2.5 SOURCE QUALITY CONTROL

2.5.1 Efflorescence Test

Conduct efflorescence tests on masonry units that are to be exposed to weathering. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. Test five pairs of specimens of each type of masonry unit for efflorescence in accordance with ASTM C 67. If any pair is rated "effloresced," reject the units represented by the samples.

2.5.2 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method," ACI 530.1. Submit calculations and certifications of unit and mortar strength.

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530.1, inspection. The Officer in Charge of Construction will serve as inspector or will select a masonry inspector.

3.1.1 Protection

- a. Stains: Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.
- b. Loads: Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed.
- c. Provide temporary bracing as required.

3.1.2 Surface Preparation

Surfaces on which masonry is to be placed shall be smooth, clean, and free of foreign substances when mortar is applied.

3.2 FIELD QUALITY CONTROL

3.2.1 Mortar Strength and Properties

ASTM C 780, for the first 3 consecutive days, and each third day thereafter.

3.2.2 Grout Strength

ASTM C 1019, for the first 3 consecutive days, and each third day thereafter, or each batch of ready-mixed grout.

3.3 WORKMANSHIP

Carry masonry up level and plumb. Furnish and use story poles or gage rods throughout the work. Changes in coursing or bonding after the work is started will not be permitted. Do not carry one section of the walls up in advance of the others. Step back unfinished work for joining with new work. Toothing will not be permitted. Check heights of masonry at sills and heads of openings to maintain the level of the walls. Build in door and window frames, louvered openings, anchors, pipes, ducts, and conduits as the masonry work progresses. Fill spaces around metal door frames solidly with mortar. Handle masonry units with care to avoid chipping, cracking, and spalling of faces and edges. Drilling, cutting, fitting, and patching to accommodate the work of others shall be performed by masonry mechanics. Cut masonry with masonry saws for exposed work. Structural steelwork, bolts, anchors, inserts, plugs, ties, lintels, and miscellaneous metalwork specified elsewhere shall be placed in position as the work progresses. Cover tops of exposed walls and partitions not being worked on with a waterproof membrane secured in place and extended down at least 2 feet on both sides. Inspect scaffolding regularly to ensure that it is amply strong, well braced, and securely tied in position. Do not overload scaffolding.

3.4 MORTAR MIXING

Measure mortar materials in one cu. ft. containers to maintain control and accuracy of proportions. Do not measure materials with shovels. Mix mortar in a mechanical batch mixer for not less than 3 nor more than 5 minutes after all ingredients are in so as to produce a uniform mixture. Add water gradually as required to produce a workable consistency. Do not load mixer beyond its rated capacity. Keep mortar boxes, pans, and mixer drums clean and free of debris and dried mortar. Retemper mortar which has stiffened because of evaporation by adding water and mixing to obtain a workable consistency. Do not use or retemper mortar which has not been placed in final position within 2 1/2 hours after the initial mixing. Do not use antifreeze compounds, salts, or other substances to lower the freezing point of mortar.

- a. Mortar: Mix mortar in accordance with ASTM C 270 to obtain type

mortar required. When masonry cement is provided, conform to masonry cement manufacturer's printed mixing instructions. During mixing, add water-repellant admixture in quantity recommended by the admixture manufacturer to mortar which will be used in exterior concrete masonry unit walls.

- b. Grout: ASTM C 476. Provide fine grout in grout spaces less than 2 inches in any horizontal dimension or in which clearance between reinforcing and masonry is less than 3/4 inch. Provide coarse grout in grout spaces 2 inches or greater in all horizontal dimensions provided the clearance between reinforcing and masonry is not less than 3/4 inch.

3.5 MORTAR JOINTS

Uniform thickness of 3/8 inch unless otherwise indicated. Tool exposed joints slightly concave with a round or other suitable jointer when the mortar is thumbprint hard. For horizontal joints, jointers shall be at least 12 inches long for brickwork and 16 inches long for concrete masonry.

Jointers shall be slightly larger than the width of the joint so that complete contact is made along the edges of the units, compressing and sealing the surface of the joint. Strike flush joints that will not be exposed. Tool vertical joints first. Brush joints to remove all loose and excess mortar. Horizontal joints shall be level; vertical joints shall be plumb and in alignment from top to bottom of wall within a tolerance of plus or minus 1/2 inch in 40 feet.

3.6 TOLERANCES

Masonry work shall be within the following limits:

- a. Face of Brick: 1/32 inch from face of adjacent brick.
- b. Face of Concrete Masonry Unit: 1/16 inch from face of adjacent unit.
- c. Variation From True Plane: 1/4 inch in 10 feet and 1/2 inch maximum in 20 feet or more.
- d. Variation From Plumb: 1/4 inch in each story, noncumulative and 1/2 inch maximum in two stories or more.
- e. Variation From Level: 1/8 inch in 3 feet, 1/4 inch in 10 feet, and 1/2 inch maximum.
- f. Variation in Wall Thickness: Plus or minus 1/4 inch.

3.7 BRICKWORK

Provide brickwork that conforms to requirements of paragraph entitled "Tolerances" of this section. Select and place brick so that better face of stretchers and headers is exposed.

3.7.1 Testing

Except during cold weather, as defined under paragraph entitled "Environmental Conditions," test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested. Ensure that each brick is nearly saturated, but surface dry when laid. During cold weather, keep masonry units dry until laid.

3.7.2 Application

Unless indicated or specified otherwise, lay brick in running bond. Completely fill joints between bricks with mortar. Form bed joints of a thick layer of mortar slightly furrowed or battered; bevel or pyramid the bed mortar. Form head joints by applying a full coat of mortar on the brick to be laid. Slushing of head joints will not be permitted. Lay closure bricks with mortar on each bedding surface of unit to be laid and units in place. Place brick carefully without disturbing brick previously laid. Dry or butt joints will not be permitted. Provide grouting as specified.

3.7.3 Brick-Faced Walls

Brick-Faced Walls: Bond brick in the pattern as indicated on the drawings. Provide additional bonding ties spaced not more than 3 feet apart around the perimeter of and within 12 inches of all openings.

- a. Collar Joints: Fill collar joints solid with mortar as each course of brick is laid. Do not disturb units in place.
- b. Brick Sills: Lay brick on edge, slope, and project not less than 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.

3.7.4 Cavity Walls

Provide a continuous cavity as indicated. Securely tie the two wythes together with horizontal joint reinforcement. Bevel mortar beds away from cavity to prevent projection into cavity when bricks are shoved in place. Keep cavities clear and clean of mortar droppings. Provide high density polyethylene dove-tailed mesh, 2 inches thick at the base of cavity wall at weep joint level. Provide weep holes of open head joints spaced 24 inches o.c. wherever the cavity is interrupted. Cavity face of interior wythe shall be dampproofed in accordance with Section 07112, "Bituminous Dampproofing."

3.8 CONCRETE MASONRY UNIT WORK

Lay the first course in a full bed of mortar for the full width of the unit. Lay succeeding courses in running bond unless otherwise indicated. Form bed-joints by applying mortar to entire top surfaces of inner and

outer face shells. Form head joints by applying mortar for a width of about one inch to ends of adjoining units. Mortar shall be of such thickness that it will be forced out of the joints as the units are placed in position. Where anchors, bolts, and ties occur within the cells of the units, place metal lath in the joint at the bottom of such cells and fill cells with mortar or grout as work progresses. Provide concrete brick for bonding walls, working out the coursing, topping out walls under sloping slabs, distributing concentrated loads, backing brick headers, and elsewhere as required. Do not dampen concrete masonry units before or during laying.

3.8.1 Special Concrete Masonry Unit Work

Where exposed concrete masonry unit walls and partitions are indicated, provide special concrete masonry unit work. Select units for uniformity of size, texture, true plane, and undamaged edges and ends of exposed surfaces. Place units plumb, parallel, and with properly tooled joints of maximum 3/8 inch thickness. Keep exposed surfaces clean and free from blemishes or defects.

3.9 BONDING AND ANCHORING

Unless indicated otherwise, extend partitions from the floor to the bottom of the construction above. Structurally bond or anchor walls and partitions to each other. Securely anchor non-load-bearing partitions and interior walls to the construction above in a manner that provides lateral stability while permitting unrestricted deflection of construction above. Completely embed anchors in mortar joints.

- a. Corners of Load-Bearing Walls: Provide a true masonry bond in each course, except where indicated or specified otherwise.
- b. Intersections of Load-Bearing Walls: Provide a true masonry bond in each course, or anchor with rigid steel anchors not more than 2 feet apart vertically, unless otherwise indicated.
- c. Intersections of Non-Load-Bearing Partitions With Other Walls or Partitions: Tie with wire mesh ties at vertical intervals of not more than 2 feet or with masonry bonding in alternate courses.

3.10 THROUGH-WALL FLASHING

Provide as indicated. Unless indicated otherwise, extend flashing from a point 1/4 inch outside of exterior face of walls, upward across wall cavity not less than 6 inches and into mortar of bed joint for backing wythe. Bend down exterior edge to form a drip. Flashing shall extend 2 inches past the cavity wall face of the backing wythe and be turned back on itself not less than 1/2 inch. Secure flashing as indicated. Provide flashing in lengths as long as practicable. Lap ends not less than 1 1/2 inches for interlocking type and 4 inches for other types. Seal laps as necessary to ensure watertight construction. Provide dams at ends of flashing where masonry abuts concrete and where flashing ends within the masonry.

3.11 WEEP HOLES

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior. Weep holes shall be open head joints 24 inches o.c.

3.12 HORIZONTAL JOINT REINFORCEMENT

Provide reinforcement where indicated in walls and partitions of concrete masonry units. Reinforcement shall be continuous except at control joints and expansion joints. Reinforcement above and below openings shall extend not less than 24 inches beyond each side of openings. Provide reinforcement in the longest available lengths, utilizing the minimum number of splices. Overlap ends not less than 6 inches. Provide welded L-shaped assemblies and welded T-shaped assemblies to match the straight reinforcement, at corners and intersections of walls and partitions. Provide mortar cover for the wire of at least 5/8 inch for exterior face of wall and 1/2 inch for interior face of wall.

3.13 CONCRETE MASONRY UNIT LINTELS AND BOND BEAMS

Provide special units, fill cells solidly with grout or concrete, and provide not less than two No. 5 reinforcing bars, unless indicated otherwise. Reinforcing shall overlap a minimum of 40 bar diameters at splices. Terminate bond beams and reinforcing on each side of expansion joints. Concrete masonry units provided for lintels and bond beams shall have exposed surfaces of the same material and texture as the adjoining masonry units. Lintels shall be straight and true and shall have at least 8 inches of bearing at each end. Allow lintels to set at least 6 days before shoring is removed. During mixing, add water-repellant admixture in quantity recommended by the admixture manufacturer to concrete and grout which will be used to fill lintels and bond beams in exterior walls.

3.14 CONTROL JOINTS

Steel should be interrupted at joints for intermediate bond beams. Steel should continue through joint for all structural bond beams. Provide where indicated in concrete masonry-unit walls. Provide sawed type or built-in type as required. Joints shall occur directly opposite each other on both faces of the wall and shall be filled with sealant as specified in Section 07920, "Joint Sealants."

3.15 GROUT PLACEMENT

Place grout from the interior side of walls, unless approved otherwise. Protect sills, ledges, offsets, and other surfaces from grout droppings. Remove grout from such surfaces immediately. Grout shall be well mixed to prevent segregation and shall be sufficiently fluid to flow into joints and around reinforcing without leaving voids. Place grout by pumping or pouring from buckets equipped with spouts in lifts not exceeding two feet. Keep pours at 1 1/2 inches below top of masonry units in top course, except at finish course. Puddle or agitate grout thoroughly to eliminate voids. Remove masonry displaced by grouting operation and re-lay in alignment with fresh mortar.

3.16 FORMS AND SHORING

Construct to the shape, lines, and dimensions of members indicated. Prevent deflections which may result in cracking or other damage to supported masonry. Do not remove until members have cured.

3.17 PARGING

Parge outside of masonry basement walls in contact with earth with two coats of Type M mortar, each 3/8 inch thick. Cross-scratch first coat and allow to cure at least 24 hours. Trowel smooth second coat, bevel at top, and cove out to edge of footing. Extend parging not more than 4 inches above grade, unless indicated otherwise, and keep damp for at least 3 days.

3.18 CLEANING

3.18.1 Protection

During cleaning operations, protect work which may be damaged, stained, or discolored.

3.18.2 Pointing

Upon completion of masonry work and before cleaning, cut out defective mortar joints and tuck point joints and all holes solidly with prehydrated mortar.

3.18.3 Cleaning

Clean exposed masonry surfaces with clear water and stiff fiber brushes and rinse with clear water. Where stains, mortar, or other soil remain, continue scrubbing with warm water and detergent. Where soil still remains on brickwork, continue cleaning as follows: Thoroughly wet exposed surfaces of dark-colored brickwork with clear water and scrub with stiff fiber brushes and a solution of not more than 1 part of muriatic acid to 9 parts of water applied to an area of 15 to 20 square feet at a time. Immediately after cleaning each area, rinse thoroughly with clear water. Do not use caustic solutions or sandblasting to clean surfaces. Masonry shall be free of stains, efflorescence, mortar or grout droppings, and debris. Restore damaged, stained, and discolored work to original condition or provide new work.

-- End of Section --

SECTION 04230

REINFORCED MASONRY
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 315	(1992) Details and Detailing of Concrete Reinforcement
ACI 318/318M	(1995) Building Code Requirements for Structural Concrete
ACI 530.1	(1995) Masonry Structures (ASCE 6-95)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 82	(1997) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 366/A 366M	(1997) Commercial Quality (CS) Steel, Carbon, (0.15 Maximum Percent) Cold-Rolled
ASTM A 497	(1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	(1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996; Rev. A) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1996; Rev. A) Axle-Steel Deformed and

	Plain Bars for Concrete Reinforcement
ASTM A 641/A 641M	(1997) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 653/A 653M	(1997) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 706/A 706M	(1996; Rev. B) Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM C 55	(1997; Rev. A) Concrete Brick
ASTM C 62	(1997; Rev. A) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 90	(1997; Rev. A) Load-Bearing Concrete Masonry Units
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 216	(1997) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(1997; Rev. A) Mortar for Unit Masonry
ASTM C 476	(1995) Grout for Masonry
ASTM C 652	(1997) Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
ASTM C 744	(1997) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	(1996) Preconstruction and Construction Evaluations of Mortars for Plain and Reinforced Unit Masonry
ASTM C 901	(1993; Rev. A) Prefabricated Masonry Panels
ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 1019	(1989; Rev. A, R 1993) Sampling and Testing Grout
ASTM C 1072	(1997; Rev. A) Measurement of Masonry Flexural Bond Strength
ASTM C 1314	(1997) Construction and Testing Masonry Prisms Used to Determine Compliance with

	Specified Compressive Strength of Masonry
ASTM D 994	(1994) Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D 1056	(1991) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 2000	(1996) Rubber Products in Automotive Applications
ASTM D 2287	(1996) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 447	(1997) Compressive Strength of Laboratory Constructed Masonry Prisms
ASTM E 514	(1990; R 1996) Water Penetration and Leakage Through Masonry
INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)	
ICBO UBC	(1994) Uniform Building Code
PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)	
PCI MNL-116	(1985) Quality Control for Plants and Production of Precast Prestressed Concrete Products

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Details of steel reinforcement

Lintels

SD-03 Product Data

Anchors, ties

Wire reinforcement

Movement joints

SD-04 Samples

Concrete masonry units ; G

Precast concrete finish; G

Sample panel; G

SD-06 Test Reports

Unit strength method

Mortar properties

Grout

Concrete masonry units

Mortar and grout admixtures

Grout strength

Mortar Strength and Properties

Field Prism Test

SD-07 Certificates

Cold weather installation

Submit procedures for meeting the requirements for installation under cold or hot weather conditions.

1.3 QUALITY ASSURANCE

1.3.1 Inspection

Inspection is required for structural masonry. Coordinate details with Section 01450, "Quality Control."

1.3.1.1 Masonry Inspection

QC Manager Quality Controls is required for structural masonry. Coordinate control requirements with Section 01450, "Quality Control".

1.3.2 Sample Panel

After material samples are approved, and prior to starting masonry work, construct one sample panel of each type and color of masonry for approval by Contracting Officer. Do not build sample panels as part of structure, but locate where directed. Provide panels not less than 4 feet long by 4 feet high. Construct panels which show full color range, texture, bond, pattern, mortar joints including tooling, anchors, joint reinforcement, wall ties, reinforcing bars, grouting, and cleaning of masonry. If a sealer is specified, apply to sample panel. Use approved sample panels as standard of workmanship. Protect from weather and construction operations until masonry work is complete and approved. Remove sample panels after completion of work.

1.3.3 Appearance

After work has started, do not change source of materials if appearance of finished work would be affected.

1.3.4 Testing

ACI 530.1, "Quality Assurance" except that the cost of the testing shall be paid by the Contractor.

1.3.5 Drawings: Details of Steel Reinforcement

Provide drawings showing all fabrication dimensions and locations for placing of the reinforcing steel and accessories.

1.3.6 Design Data: Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method," ACI 530.1. Submit calculations and certifications of unit and mortar strength.

1.3.7 Test Reports: Mortar and Grout Admixtures

Submit test reports indicating that mortar and grout properties are as specified when the admixtures are used.

1.4 DELIVERY, STORAGE, AND HANDLING

- a. Handle masonry units to avoid chipping and breaking. Deliver cement and lime in unbroken bags, barrels, or other sealed containers. Containers shall be plainly marked and labeled with manufacturer's name and brand.
- b. Protect masonry units from contact with the soil. Protect moisture-controlled units from rain or ground water. Keep anchors, ties, and reinforcement free of loose rust and scale. Keep cementitious materials dry. Store and handle cement to prevent inclusion of foreign materials. Store aggregates in a manner to avoid contamination or segregation.

1.5 BRACING AND SCAFFOLDING

Provide all bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

2.1.1 Hollow Load and Non-Load Bearing Units

ASTM C 90, Type I, normal weight. Nominal size as specified on The Contract Documents.

2.2 MORTAR

2.2.1 Mortar Properties

ASTM C 270, Type M S. Strength (f'm) as indicated. Test in accordance with ASTM C 780. Use Type IS IP blended hydraulic cement.

2.2.2 Admixtures

Do not use admixtures containing chlorides.

2.2.2.1 Air Entrainment

When structural reinforcement is incorporated, maximum air-content 12 percent in cement-lime mortar and 18 percent in masonry cement mortar.

2.2.3 Water

Water for mixing shall be potable.

2.3 GROUT

ASTM C 476, fine. Slump between 8 and 11 inches. Provide minimum grout strength of 2000 psi in 28 days, as tested by ASTM C 1019.

2.3.1 Admixtures

Do not use air-entrainment, anti-freeze or chloride admixtures.

2.3.2 Ready Mixed Grout

ASTM C 94.

2.4 ANCHORS, TIES

Stainless steel, ASTM A 167 Type 304-, or zinc-coated steel, galvanized after fabrication, ASTM A 153/A 153M, B-2, for wire not totally embedded. Optionally, for completely embedded wire, ASTM A 641/A 641M, Class 1 or 3. Do not use corrugated wall ties.

- a. Plate, headed and bent bar anchors, ASTM A 36/A 36M.
- b. Sheet metal anchors and ties, ASTM A 366/A 366M, ASTM A 653/A 653M.
- c. Wire mesh ties, ASTM A 185.
- d. Wire ties and anchors, ASTM A 82.

2.4.1 Horizontal Joint Reinforcement and Wire Reinforcement

Fabricate from cold drawn steel wire, ASTM A 82. Hot-dip galvanize after fabrication, ASTM A 153/A 153M, B-2. Provide ACI 530.1 truss type reinforcement with two or more longitudinal wires welded to continuous diagonal cross wire, or ladder type with perpendicular cross wires not more than 16 inches o.c.

2.4.1.1 Wire Fabric

ASTM A 185 smooth, ASTM A 497 deformed.

2.4.2 Adjustable Anchors

Provide adjustable anchors 3/16 inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 5/16 inch diameter steel bars placed to provide 1/16 inch play between flexible anchors and structural steel members.

2.5 REINFORCING BARS

2.5.1 Deformed Bars

ASTM A 615/A 615M, ASTM A 616/A 616M, ASTM A 617/A 617M, or ASTM A 706/A 706M.

2.5.2 Fabrication

ACI 530.1.

2.5.3 Bar Positioners

Provide non-metallic positioners that prevent displacement of reinforcing during construction.

2.6 PRECAST CONCRETE ITEMS

PCI MNL-116. Provide lifting devices for items weighing over 80 pounds.

2.6.1 Design

ACI 318/318M for flexural and shear strength. Concrete shall have a minimum 28 day compressive strength of 3500 pounds per square inch using 1/2 inch to No. 4 nominal-size coarse aggregate. Reinforcement ASTM A 615/A 615M, Grade 60. Limit lintel deflection due to dead plus live load to L/600 or 0.3 inches. Provide top and bottom bars for lintels over 36 inches in length. Provide 1 1/2 inch minimum cover, top and bottom.

2.6.2 Exposed Surfaces

Provide finish grade B surface finish.

2.6.3 Sills

Cast sills with washes. Cast sills for windows and mullions in sections with head joints at mullions and 1/4 inch allowance for mortar joints. Provide rounded nosings on treads of exterior door sills. Roughen ends of sills, except for 3/4 inch wide margin at exposed surfaces, for bond. Reinforce sills with not less than two No. 4 bars.

2.6.4 Lintels

Maintain minimum clearance of 3/4 inch between reinforcement and interior faces of units. Reinforce for full length and sufficient length beyond end of item to allow splicing or tying to building reinforcement.

2.7 PREFABRICATED MASONRY ELEMENTS

ASTM C 901. Mark panels for proper location and orientation.

2.8 THROUGH-WALL FLASHING

2.8.1 Stainless Steel

ASTM A 167, Type 304, 0.010 inch minimum thickness. Provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations. Lap seams 3 to 4 inches. Use lead-free solder.

2.9 MOVEMENT JOINTS

2.9.1 Contraction Joint Material

2.9.1.1 PVC Shear Key

ASTM D 2287, Type PVC 654-4. Minimum durometer hardness of 85.

2.9.1.2 Elastomeric Joint Sealant

ASTM C 920.

2.9.1.3 Joint Detail

Size and shape indicated.

2.9.2 Expansion Joint Material

ASTM D 994, ASTM D 1056 Class RE 41, ASTM C 920. Resistant to oils and solvents.

2.9.2.1 Joint Detail

Size and shape indicated.

PART 3 EXECUTION

3.1 INSPECTION

Prior to start of work, masonry inspector shall verify the foundation conditions listed in ACI 530.1.

3.2 SPECIAL PREPARATION

3.2.1 Cold Weather Installation

When either of the following conditions exist:

- a. Ambient temperature falls below 40 degrees F, or
- b. Temperature of masonry units is below 40 degrees F,

implement cold weather procedures of ACI 530.1.

3.3 ERECTION OF MASONRY UNITS

3.3.1 Mortar

Mix all cementitious materials and aggregates between 3 and 5 minutes in mechanical batch mixer with sufficient amount of water to produce workable consistency. Do not hand mix without approval of Masonry Inspector. Do not retemper after 2 1/2 hours.

3.3.2 Bond

Construct masonry in running bond pattern.

3.3.3 Solid Units

ACI 530.1, place with fully mortared bed and head joints.

3.3.4 Hollow Units

ACI 530.1.

3.3.5 All Units

- a. Place clean units while mortar is soft and plastic. Any unit disturbed to the extent that initial bond is broken shall be removed and relaid in fresh mortar.
- b. Cut exposed edges or faces of masonry units smooth or position so that all exposed faces or edges are unaltered manufactured surfaces.
- c. At end of each day, cover new work. Step back masonry; do not tooth.

3.3.6 Tolerances

ACI 530.1.

3.3.7 Prefabricated Units

Erect as indicated.

3.3.8 Embedded Items and Accessories

- a. Construct chases as masonry units are laid.

- b. Coordinate installation of pipes and conduits passing through walls, piers, or beams as indicated. Use steel sleeves where indicated.
- c. Install and secure anchors, flashing, weep holes, nailing blocks, and other accessories as indicated.

3.3.9 Bed and Head Joints

Joints shall be 3/8 inch thick, except that bed joint of starting course placed over foundations may be 1/4 inch to 3/4 inch thick.

3.3.10 Finishing Joints

- a. In exposed and below grade masonry, fill holes created by line pins with mortar.
- b. Remove masonry protrusions extending 1/2 inch or more into cells or cavities to be grouted.

3.3.11 Collar Joints

Solidly fill collar joints less than 3/4 inch wide with mortar as job progresses.

3.3.12 Through-Wall Flashing

Provide as indicated. Extend flashing from a point 1/4 inch outside of exterior face of walls, upward across wall cavity not less than 6 inches and into mortar of bed joint for backing wythe. Bend down exterior edge to form a drip. Flashing shall be extended 2 inches past the cavity wall face of the backing wythe and be turned back on itself not less than 1/2 inch. Secure flashing as indicated. Provide flashing in lengths as long as practicable. Lap ends not less than 1 1/2 inches for interlocking type and 4 inches for other types. Seal laps as necessary to ensure watertight construction. Provide dams at ends of flashing where masonry abuts other construction materials and where flashing ends within the masonry. When both wythes are not brought up together, protect flashing, from damage until they are fully enclosed in the wall.

3.3.13 Weep Holes

Wherever through-wall flashing occurs, provide weep holes spaced 20 inches o.c. for brick faced walls and 32 inches o.c. for masonry unit construction.

3.4 REINFORCEMENT

3.4.1 Preparation

At time mortar or grout is placed, all reinforcement shall be free of mud, oil or other materials that might reduce bond.

3.4.2 Placing Tolerances

- a. Place steel in walls and flexural elements within 1/2 inch when the distance (d) from centerline of steel to opposite face of masonry is equal to 8 inches or less, within one inch for d between 8 and 24 inches.
- b. Place vertical bars in wall within 2 inches of indicated location along length of wall.
- c. Bars may be moved as necessary to avoid interference with other reinforcing, conduits, or embedded items. If bars are moved more than specified tolerance, notify Contracting Officer for approval for resulting arrangement.

3.4.3 Securing Reinforcement

Support and fasten reinforcement to prevent displacement by construction loads or placement of grout or mortar. Lap or hook corner bars.

3.4.4 Details of Reinforcement

- a. Clear distance between reinforcing bars and any face of masonry unit or formed surface, shall be as indicated but not less than 1/2 inch.
- b. Get approval from Contracting Officer for all splices not indicated.
- c. Do not bend embedded reinforcement.
- d. Place joint reinforcement so that longitudinal wires are embedded in mortar with minimum cover of 1/2 inch when not exposed to weather or earth and 5/8 inch when exposed to weather or earth.

3.4.5 Wall Ties

Embed ends of wall ties in mortar joints.

3.4.5.1 Hollow Units

Wall tie ends shall engage outer face shells by at least 1/2 inch.

3.4.5.2 Solid Units

Embed wire wall ties at least 1 1/2 inch into mortar bed.

3.4.5.3 Minimum Number of Ties

Bond wythes with No. 9 gage ties, one tie per 2.67 square feet. Bond wythes with 3/16 inch diameter ties, one tie per 4.50 square feet. Maximum spacing between ties, 36 inches horizontally and 24 inches vertically. The spacing for ties with an integral drip shall be one-half the spacing given.

3.4.5.4 Adjustable Ties

- a. Use one tie for each 1.77 square feet of wall area.
- b. Do not exceed 16 inch spacing horizontally or vertically.
- c. 1 1/4 inch maximum misalignment of bed joints from one wythe to the other.
- d. 1/16 inch maximum clearance between connecting parts of ties.
- e. Ties shall have at least two 3/16 inch diameter pintle legs.

3.4.6 Adjustable Anchors

Weld spacers to rods and columns. Provide shapes standard with the flexible-anchor manufacturer when approved. Clean welds and give one coat of zinc-rich touch up paint.

3.5 GROUTING

3.5.1 Preparation

Ensure that spaces to be grouted are free of mortar droppings, debris, loose aggregates and any material deleterious to masonry grout. Reinforcement and ties shall be in place before grouting.

3.5.2 Cleanouts

- a. When grout pour exceeds 5 feet in height, provide cleanouts in bottom course of masonry in each grout pour.
- b. Provide 3 inch minimum cleanout openings.
- c. After cleaning, close cleanout openings and brace to resist grout pressure.

3.5.3 Placing Time

Place grout within 1-1/2 hours of introducing water to mixture. Sample and test grout, ASTM C 1019, for each 5,000 square feet of wall.

3.5.4 Pour Height

ACI 530.1.

3.5.5 Lift Height

Place grout in lifts not exceeding 5 feet. For 8 inch block wall, maximum lift is 2 feet.

3.5.6 Consolidation

Consolidate grout at time of placement.

- a. Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.
- b. Consolidate pours exceeding 12 inches in height by mechanical vibration. Reconsolidate by mechanical vibration after initial water loss and settlement have occurred.

3.6 FIELD QUALITY CONTROL

3.6.1 Mortar Strength and Properties

ASTM C 780, for the first 3 consecutive days, and each third day thereafter.

3.6.2 Grout Strength

ASTM C 1019, for the first 3 consecutive days, and each third day thereafter, or each batch of ready mixed grout.

3.6.3 Field Prism Test

ASTM C 1314, make at least one prism test sample for each 5,000 square feet of wall, but not less than three such samples for any building.

3.7 BUILT-IN WORK

As work progresses, install built-in door, window, frames, anchor bolts and plates as indicated. Fill frame voids and adjacent masonry cores solidly with grout.

3.8 CLEANING

- a. Keep exposed surfaces clean during construction. Avoid smearing mortar on face of units.
- b. Clean masonry with potable water. Detergents may be used.
- c. Do not use acid, caustic solutions, or sandblasting.
- d. Masonry shall be free of stains, efflorescence, mortar or grout droppings, and debris.

-- End of Section --

SECTION 05120

STRUCTURAL STEEL
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO HB14 (1992) Highway Bridges

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC M013 (1983) Detailing for Steel Construction

AISC M016 (1989) ASD Manual of Steel Construction

AISC M017 (1992; Errata 1994) Connections

AISC M018L (1994) LRFD Manual of Steel Construction
Volume I

AISC M019L (1994) LRFD Manual of Steel Construction
Volume II

AISC S303 (1992) Steel Buildings and Bridges

AISC S329 (1985) Allowable Stress Design
Specification for Structural Joints Using
ASTM A 325 or A 490 Bolts

AISC S334L (1988) Load and Resistance Factor Design
Specifications for Structural Joints Using
ASTM A 325 or A 490 Bolts

AISC S335 (1989) Structural Steel Buildings
Allowable Stress Design and Plastic Design

AISC S340 (1992) Metric Properties of Structural
Shapes with Dimensions According to ASTM
A6M

AISC S341 (1992) Seismic Provisions for Structural
Steel Buildings

AISC S342L (1993) Load and Resistance Factor Design

Specification for Structural Steel
Buildings

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA MRE (1996) Manual for Railway Engineering
(Fixed Properties)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ANSI/ASME B46.1 (1995) Surface Texture, (Surface
Roughness, Waviness, and Lay)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1996) Carbon Structural Steel

ASTM A 53 (1996) Pipe, Steel, Black and Hot-Dipped,
Zinc-Coated Welded and Seamless

ASTM A 108 (1995) Steel Bars, Carbon, Cold Finished,
Standard Quality

ASTM A 123/A 123M (1997) Zinc (Hot-Dip Galvanized) Coatings
on Iron and Steel Products

ASTM A 143 (1974; R 1994) Safeguarding Against
Embrittlement of Hot-Dip Galvanized
Structural Steel Products and Procedure
for Detecting Embrittlement

ASTM A 153/A 153M (1995) Zinc Coating (Hot-Dip) on Iron and
Steel Hardware

ASTM A 242/A 242M (1993; Rev. A) High-Strength Low-Alloy
Structural Steel

ASTM A 307 (1994) Carbon Steel Bolts and Studs,
60,000 psi Tensile Strength

ASTM A 325M (1993) High-Strength Bolts for Structural
Steel Joints (Metric)

ASTM A 325 (1997) Structural Bolts, Steel, Heat
Treated, 120/105 ksi Minimum Tensile
Strength

ASTM A 490M (1993) Heat-Strength Steel Bolts, Classes
10.9 and 10.9.3, for Structural Steel
Joints (Metric)

ASTM A 490 (1997) Heat-Treated Steel Structural
Bolts, 150 ksi Minimum Tensile Strength

ASTM A 500	(1996) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 514/A 514M	(1994; Rev. A) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 563M	(1996) Carbon and Alloy Steel Nuts (Metric)
ASTM A 563	(1996) Carbon and Alloy Steel Nuts
ASTM A 572/A 572M	(1997) High-Strength Low-Alloy Columbium-Vanadium of Structural Steel
ASTM A 588/A 588M	(1997) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 618	(1996) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 668/A 668M	(1996) Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 852/A 852M	(1997) Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick
ASTM B 695	(1991) Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C 827	(1995; Rev. A) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM C 1107	(1997) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 436	(1993) Hardened Steel Washers
ASTM F 844	(1990) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959M	(1996) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric)

ASTM F 959 (1996) Compressible-Washer-Type Direct
Tension Indicators for Use with Structural
Fasteners

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1 (1998) Structural Welding Code - Steel

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70 (1994) Electric Overhead Traveling Cranes

FEDERAL SPECIFICATIONS (FS)

FS TT-P-664 (Rev. D) Primer Coating, Alkyd,
Corrosion-Inhibiting, Lead and Chromate
Free, VOC-Compliant

MILITARY SPECIFICATIONS (MIL)

MIL-P-24441 (Rev. B; Supp. 1) Paint, Epoxy-Polyamide

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 3 (1995) Power Tool Cleaning

SSPC SP 6 (1994) Commercial Blast Cleaning

SSPC Paint 25 (1991) Red Iron Oxide, Zinc Oxide, Raw
Linseed Oil and Alkyd Primer (Without Lead
and Chromate Pigments)

SSPC PA 1 (1991) Shop, Field, and Maintenance
Painting

1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer or galvanizing, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC M016 and AISC M017 except as modified in this contract.

1.3 MODIFICATIONS TO REFERENCES

In AISC M016, AISC M017, AISC S335, AISC S303, AISC S329, and AISC S340, except as modified in this section, shall be considered a part of AISC M016 and AISC M017 and is referred to in this section as AISC M016 and AISC M017.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Fabrication drawings; G

SD-03 Product Data

Shop primer

SD-06 Test Reports

Class B coating

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Shop primer

Welding electrodes and rods

Nonshrink grout

Galvanizing

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC M013, AISC M016 and AISC M017. Drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS standard welding symbols.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A 36/A 36M.

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel

2.2.1.1 Bolts

ASTM A 325, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A 563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436 washers for ASTM A 325 and ASTM A 490 bolts.

2.2.2 High-Strength Structural Steel

2.2.2.1 Bolts

ASTM A 325, Type 1 ASTM A 490, Type 1 or 2.

2.2.2.2 Nuts

ASTM A 563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.2.3 Washers

ASTM F 436, plain carbon steel.

2.2.3 Foundation Anchorage

2.2.3.1 Bolts

ASTM A 307.

2.2.3.2 Nuts

ASTM A 563, Grade A, hex style.

2.2.3.3 Washers

ASTM F 844.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1.

2.3.2 Nonshrink Grout

ASTM C 1107, with no ASTM C 827 shrinkage. Grout shall be nonmetallic.

2.4 SHOP PRIMER

FS TT-P-664, SSPC Paint 25, or MIL-P-24441/1 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC M016 and AISC M017 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 GALVANIZING

ASTM A 123/A 123M or ASTM A 153/A 153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

2.6.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.6.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Contracting Officer.

2.6.2.1 Cleaning

SSPC SP 6, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating

manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

PART 3 EXECUTION

3.1 INSTALLATION

3.2 ERECTION

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC S335. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt and pin holes. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.3.1 Common Grade Bolts

ASTM A 307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.3.2 High-Strength Bolts

ASTM A 325 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.4 WELDING

AWS D1.1. Grind exposed welds smooth as indicated. Provide AWS D1.1 qualified welders, welding operators, and tackers.

3.4.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.6 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.7.1 Welds

3.7.1.1 Visual Inspection

AWS D1.1. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.7.2 High-Strength Bolts

3.7.2.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 2 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC S329, Table 4, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

3.7.2.2 Inspection

Inspection procedures shall be in accordance with AISC S329, Section 9. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

3.7.2.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an

ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

-- End of Section --

SECTION 06100

ROUGH CARPENTRY
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN FOREST & PAPER ASSOCIATION (AFPA)

AFPA NDS (1991) National Design Specification for
Wood Construction and Supplement 1991
Design Values for Wood Construction

AFPA WCD1 (1988) Manual for Wood Frame Construction:
Wood Construction Data 1

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

ANSI/AITC A190.1 (1992) Structural Glued Laminated Timber

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.2.1 (1996) Square and Hex Bolts and Screws
Inch Series

ANSI B18.5.2.1M (1981; R 1995) Metric Round Head Short
Square Neck Bolts

ANSI B18.6.1 (1981; R 1997) Wood Screws (Inch Series)

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA E30 (1996) Design/Construction Guide,
Residential and Commercial

APA E445 (1996) Structural-Use Panels (APA PRP-108)

APA F405 (1995) Performance Rated Panels

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B18.2.2 (1987; R 1993) Square and Hex Nuts (Inch
Series)

ANSI/ASME B18.5.2.2M (1982; R 1993) Metric Round Head Square
Neck Bolts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 687	(1993) High-Strength Nonheaded Steel Bolts and Studs
ASTM C 79/C 79M	(1997) Treated Core and Nontreated Core Gypsum Sheathing Board
ASTM C 208	(1995) Cellulosic Fiber Insulating Board
ASTM F 1667	(1995) Driven Fasteners: Nails, Spikes, and Staples

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(1996) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C2	(1996) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C9	(1996) Plywood - Preservative Treatment by Pressure Process
AWPA C20	(1996) Structural Lumber - Fire-Retardant Treatment by Pressure Processes
AWPA C27	(1996) Plywood - Fire-Retardant Treatment by Pressure Processes
AWPA C28	(1995) Structural Glued Laminated Members and Laminations Before Gluing, Pressure Treatment
AWPA M2	(1996) Inspection of Treated Wood Products
AWPA M6	(1996) Brands Used on Forest Products

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1923	(Rev. A) Shield, Expansion (Lag Shield)
CID A-A-1924	(Rev. A) Shield, Expansion (Self Drilling Tubular Expansion Shell)
CID A-A-1925	(Rev. A) Shield, Expansion (Nail Anchors)

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM LPDS 1-49 (1985) Perimeter Flashing

FEDERAL SPECIFICATIONS (FS)

FS MM-T-371 (Rev. E) Ties, Railroad, Wood (Cross and Switch)

FS FF-B-588 (Rev. E) Bolt, Toggle: and Expansion Sleeve, Screw

FS UU-B-790 (Rev. A Reinst) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

FS FF-T-1813 Tack

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC (1994) Uniform Building Code

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA SGRNL (1997) Standard Grading Rules for Northeastern Lumber

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA RMIHC (1994) Rules for the Measurement and Inspection of Hardwood and Cypress

U.S. DEPARTMENT OF COMMERCE PRODUCT STANDARDS (PS)

PS-1 (1995) Construction and Industrial Plywood

PS-2 (1993) Wood-Base Structural-Use Panels

PS-20 (1970; R 1986) American Softwood Lumber Standard

PS-56 (1973) Structural Glued Laminated Timber

PS-58 (1974) Basic Hardboard

REDWOOD INSPECTION SERVICE (RIS)

RIS GCRL (1995) Grades of California Redwood Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA GSC (1986; Supp. 1993) Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB SPIBGR (1994) Southern Pine Inspection Bureau
Grading Rules

TRUSS PLATE INSTITUTE (TPI)

ANSI/TPI-1 (1995) National Design Standard for Metal
Plate Connected Wood Trusses

TPI HIB (1991) Handling, Installing and Bracing of
Metal Plate Connected Wood Trusses

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (1996; Supp. VII & VIII) Standard Grading
and Dressing Rules for Douglas Fir,
Western Hemlock, Western Red Cedar, White
Fir, Sitka Spruce Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA WLGR (1995) Western Lumber Grading Rules

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal
Procedures."

SD-02 Shop Drawings

Trussed rafters; G

Trussed joists; G

Fabricated structural members; G

Modifications of structural members; G

SD-05 Design Data

Modifications of structural members; G

SD-06 Test Reports

Preservative-treated lumber and plywood

SD-07 Certificates

Certificates of grade

1.3 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store materials
off the ground to provide proper ventilation, with drainage to avoid

standing water, and protection against ground moisture and dampness. Store materials with a moisture barrier at both the ground level and as a cover forming a well ventilated enclosure. Remove defective and damaged materials and provide new materials.

1.4 GRADING AND MARKING

1.4.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used.

1.4.2 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark shall identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with PS-1.

1.4.3 Structural-Use and OSB Panels

Mark each panel with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the panel. The mark shall indicate end use, span rating, and exposure durability classification. Oriented Strand Board (OSB), APA F405.

1.4.4 Preservative-Treated Lumber and Plywood

The Contractor shall be responsible for the quality of treated wood products. Each treated piece shall be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor shall provide Contracting Officer's Representative (COR) with the inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.4.5 Hardboard

Mark each sheet or bundle to identify the standard under which the material is produced and the producer.

1.5 SIZES AND SURFACING

PS-20 for dressed sizes of yard and structural lumber. Lumber shall be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced. Other measurements are IP or SI standard.

1.6 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products shall be as follows at the time of delivery to the job site:

- a. Framing lumber and boards - 19 percent maximum
- b. Materials other than lumber - Moisture content shall be in accordance with standard under which the product is produced

1.7 PRESERVATIVE TREATMENT

Treat lumber and timber in accordance with AWPA C1 and AWPA C2, and plywood in accordance with AWPA C1 and AWPA C9. All wood shall be air or kiln dried after treatment. Specific treatments shall be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Brush coat areas that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. The following items shall be preservative treated:

- a. Wood sills, soles, plates, furring and nailers that are set into or in contact with concrete or masonry.

1.8 QUALITY ASSURANCE

1.8.1 Drawing Requirements

For fabricated structural members, trusses, glu-lam members, indicate materials, details of construction, methods of fastening, and erection details. Include reference to design criteria used and manufacturers design calculations. Submit drawings for all proposed modifications of structural members. Do not proceed with modifications until the submittal has been approved.

1.8.2 Data Required

Submit calculations and drawings for all proposed modifications of structural members. Do not proceed with modifications until the submittal has been approved.

1.8.3 Certificates of Grade

Submit certificates attesting that products meet the grade requirements specified in lieu of grade markings where appearance is important and grade marks will deface material.

PART 2 PRODUCTS

2.1 LUMBER

2.1.1 Framing Lumber

Framing lumber such as studs, plates, caps, collar beams, cant strips, bucks, sleepers, nailing strips, and nailers and board lumber such as subflooring and wall and roof sheathing shall be one of the species listed in the table below. Minimum grade of species shall be as listed.

Table of Grades for Framing and Board Lumber

<u>Grading Rule</u>	<u>Specie</u>	<u>Framin</u>	<u>Board Lumber</u>
WWPA WLGR standard grading rules	Aspen Douglas Fir-Larch Douglas Fir South Engelmann Spruce -Lodgepole Pine Engelmann Spruce Hem-Fir Idaho White Pine Lodgepole Pine Mountain Hemlock Mountain Hemlock -Hem-Fir Ponderosa Pine -Sugar Pine Ponderosa Pine -Lodgepole Pine Subalpine Fir White Woods Western Woods Western Cedars Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: No. 3 Common
WCLIB 17 standard grading rules	Douglas Fir-Larch Hem-Fir Mountain Hemlock Sitka Spruce Western Cedars Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: Standard
SPIB SPIBGR standard grading rules	Southern Pine	Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	No. 2 Boards
SCMA GSC standard specifications	Cypress	No. 2 Common	No. 2 Common
NELMA SGRNL standard grading	Balsam Fir Eastern Hemlock	All Species: Standard Light	All Species: No. 3 Common

Table of Grades for Framing and Board Lumber

<u>Grading Rule</u> rules	<u>Specie</u>	<u>Framin</u>	<u>Board Lumber</u>
	-Tamarack	Framing or No.	except Stan-
	Eastern Spruce	3 Structural	dard for
	Eastern White	Light Framing	Eastern White
	Pine	(Stud Grade for	and Northern
	Northern Pine	2x4 nominal size,	Pine
	Northern Pine	10 feet and	
	Cedar	shorter)	
RIS GCRL standard specifications	Redwood	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	Construction Heart
NHLA RMIHC rules for the measurement and inspection of hardwood and cypress lumber	Cypress	No. 2 Dimension	No. 2 Common

2.2 PLYWOOD, STRUCTURAL-USE, AND ORIENTED STRAND BOARD (OSB) PANELS

PS-1, PS-2, APA E445, and APA F405 respectively.

2.2.1 Roof Sheathing

2.2.1.1 Plywood

C-D Grade, Exposure 1, with an Identification Index of not less than 24/0 .

2.2.1.2 Structural-Use Panel

Sheathing grade with durability equivalent to Exposure 1, Span Rating of 24/0 or greater.

2.3 OTHER MATERIALS

2.3.1 Trussed Rafters

Metal plate connected trusses designed in accordance with ANSI/TPI-1 and TPI HIB and fabricated in accordance with ANSI/TPI-1.

2.3.2 Trussed Joists

Metal plate connected parallel chord wood trusses designed and fabricated

in accordance with ANSI/TPI-1.

2.4 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware shall be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials shall be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs shall be zinc-coated.

2.4.1 Bolts, Nuts, Studs, and Rivets

ANSI B18.2.1, ANSI B18.5.2.1M, ANSI/ASME B18.5.2.2M, ASME/ANSI B18.2.2, and ASTM A 687.

2.4.2 Expansion Shields

CID A-A-1923, CID A-A-1924, and CID A-A-1925. Except as shown otherwise, maximum size of devices shall be 3/8 inch.

2.4.3 Lag Screws and Lag Bolts

ANSI B18.2.1.

2.4.4 Toggle Bolts

FS FF-B-588.

2.4.5 Wood Screws

ANSI B18.6.1.

2.4.6 Wire Nails

ASTM F 1667.

2.4.7 Tacks

FS FF-T-1813.

2.4.8 Joist Hangers

Steel or iron, zinc coated, sized to fit the supported member, of sufficient strength to develop the full strength of the supported member in accordance with ICBO UBC, and furnished complete with any special nails required.

2.4.9 Joist Anchors

For joists supported by masonry walls, provide anchors 3/16 by 1 1/2 inch steel tee or strap, bent and of length to provide 4 inches embedment into wall and 12 inches along joist except as indicated otherwise. For joists

parallel to masonry or concrete walls, provide anchors 1/4 by 1 1/4 inch minimum cross-sectional area, steel strap, length as necessary to extend over top of first three joists and into wall 4 inches, and with wall end of bend or pin type , except as indicated otherwise.

2.4.10 Door Buck Anchors

Metal anchors, 1/8 by 1 1/4 inch steel, 12 inches long, with ends bent 2 inches , except as indicated otherwise. Anchors shall be screwed to the backs of bucks and built into masonry or concrete. Locate 8 inches above sills and below heads and not more than 24 inches intermediately between. Anchorage of bucks to steel framing shall be as necessary to suit the conditions.

2.4.11 Toothed Rings and Shear Plates

AFPA NDS.

2.4.12 Beam Anchors

Steel U-shaped strap anchors 1/4 inch thick by 1 1/2 inches wide , except as indicated otherwise.

2.4.13 Panel Edge Clips

Extruded aluminum or galvanized steel, H-shaped clips to prevent differential deflection of roof sheathing.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to AFPA WCD1 unless otherwise indicated or specified. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Do not splice framing members between bearing points. Set joists, rafters, and purlins with their crown edge up. Frame members for the passage of pipes, conduits, and ducts. Do not cut or bore structural members for the passage of ducts or pipes without approval. Reinforce all members damaged by such cutting or boring by means of specially formed and approved sheet metal or bar steel shapes, or remove and provide new, as approved. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spiking and nailing not indicated or specified otherwise shall be in accordance with the Nailing Schedule contained in ICBO UBC; perform bolting in an approved manner. Spikes, nails, and bolts shall be drawn up tight. Timber connections and fastenings shall conform to AFPA NDS. Use slate or steel shims when leveling joists, beams, and girders on masonry or concrete. Do not use shimming on wood or metal bearings.

3.1.1 Sills

3.1.1.1 Anchors in Masonry

Except where indicated otherwise, Embed anchor bolts not less than 15 inches

in masonry unit walls and provide each with a nut and a 2 inch diameter washer at bottom end. Fully grout bolts with mortar.

3.1.2 Beams and Girders

Set beams and girders level and in alignment and anchor to bearing walls, piers, or supports with U-shaped steel strap anchors. Embed anchors in concrete or masonry at each bearing and through-bolt to the beams or girders with not less than two bolts. Provide bolts not less than 1/2 inch in diameter and with plate washers under heads and nuts. Install beams and girders not indicated otherwise with 8 inch minimum end bearing on walls or supports. Install beams and girders into walls with 1/2 inch clearance at the top, end, and sides. Provide joints and splices over bearings only and bolt or spike together.

3.1.3 Joists

Provide joists of the sizes and spacing indicated, accurately and in alignment, and of uniform width. Joists shall have full bearing on plates, beams, and trusses; provide laps over bearing only and spike. Where joists are of insufficient length to produce a 12 inch lap, butt joists over bearing and provide wood scabs 2 nominal inches thick by depth of joists by 24 inches long or metal straps 1/4 by 1 1/2 inch by not less than 18 inches long nailed to each joist with not less than four 10-penny nails, or approved sheet metal connectors installed in accordance with the manufacturer's recommendations. The minimum joist end bearing shall be 4 inches. For joists approved to be bored for the passage of pipes or conduits, bore through the neutral axis of the joist. Provide steel joist hangers of proper size and type to receive the ends of all framed joists.

3.1.3.1 Joist Anchors

Provide anchors for each fourth joist supported by a masonry wall. Build wall end of anchors into the wall. Nail anchor to the joist with three 10-penny nails spaced 2 inches o.c. Anchor the first three joists parallel to concrete or masonry walls at bridging points, but not less than 8 feet o.c. from end walls. Let anchors into the tops of each joist and spike to the top of joist with one 10-penny nail. Extend anchors at least 4 inches into the wall.

3.1.4 Ceiling Joists

Size as indicated and set accurately and in alignment. Toe-nail joists to all plates with not less than three 10-penny nails. Frame openings in ceilings with headers and trimmers.

3.1.5 Rafters

Size as indicated, set accurately, and form a true plane. Ridge hip and valley members shall be of ample depth to receive beveled ends of rafters and shall be nominally 2 inches thick. Rafters shall be notched and have full and solid bearing on plates. Toe-nail rafters to plates and ridge valley hip member with at least three 10-penny nails and nail to adjoining ceiling joists with at least four 10-penny nails. Adequately frame

openings in roofs with headers and trimmers. Double headers and trimmers carrying or supporting two or more rafters.

3.1.6 Metal Framing Anchors

Provide framing anchors at every rafter or trussed rafter to fasten rafter or trussed rafter to plates and studs against uplift movement and forces as indicated. Anchors shall be punched and formed for nailing so that nails will be stressed in shear only. Nails shall be zinc-coated; drive a nail in each nail hole provided in the anchor.

3.1.7 Trusses

Metal plate connected wood trusses shall be handled, erected, and braced in accordance with TPI HIB and as indicated.

3.1.8 Plywood and Structural-Use Panel Roof Sheathing

Install with the grain of the outer plies or long dimension at right angles to supports. Stagger end joints and locate over the centerlines of supports. Allow 1/8 inch spacing at panel ends and 1/4 inch at panel edges. Nail panels with 8-penny common nails or 6-penny annular rings or screw-type nails spaced 6 inches o.c. at supported edges and 12 inches o.c. at intermediate bearings. Do not use staples in roof sheathing. Where the support spacing exceeds the maximum span for an unsupported edge, provide adequate blocking, tongue-and-groove edges, or panel edge clips, in accordance with APA E30.

3.2 MISCELLANEOUS

3.2.1 Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

3.2.1.1 Roof Nailing Strips

Provide roof nailing strips for roof decks as indicated. Apply nailing strips in straight parallel rows in the direction and spacing indicated. Strips shall be surface applied.

- a. Surface-Applied Nailers: Shall be 3 inches wide and of thickness to finish flush with the top of the insulation. Anchor strips securely to the roof deck with powder actuated fastening devices or expansion shields and bolts, spaced not more than 24 inches o.c. On decks with slopes of one inch or more, provide surface applied wood nailers for securing insulation.
- b. Embedded Nailers: Shall be nominal 2 by 3 with 2 inch sides beveled. Set and anchor nailers to finish flush with the roof deck surface.

3.2.1.2 Roof Edge Strips and Nailers

Provide at perimeter of roof, around openings through roof, and where roofs abut walls, and other vertical surfaces. Except where indicated otherwise, nailers shall be 6 inches wide and the same thickness as the insulation. Anchor nailers securely to underlying construction. Anchor perimeter nailers in accordance with FM LPDS 1-49. Strips shall be grooved for edge venting; install at walls, curbs, and other vertical surfaces with a 1/4 to 1/2 inch air space.

3.2.2 Rough Wood Bucks

Size as indicated . Set wood bucks true and plumb. Anchor bucks to concrete or masonry with steel straps extending into the wall 8 inches minimum. Place anchors near the top and bottom of the buck and space uniformly at 2 foot maximum intervals.

3.2.3 Wood Blocking

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

3.2.4 Wood Grounds

Provide for fastening wood trim, finish materials, and other items to plastered walls and ceilings. Install grounds in proper alignment and true with an 8 foot straightedge.

3.2.5 Wood Furring

Provide where shown and as necessary for facing materials specified. Except as shown otherwise, furring strips shall be nominal one by 3, continuous, and spaced 16 inches o.c. Erect furring vertically or horizontally as necessary. Nail furring strips to masonry. Do not use wood plugs. Provide furring strips around openings, behind bases, and at angles and corners. Furring shall be plumb, rigid, and level and shall be shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required. Form furring for offsets and breaks in walls or ceilings on 1 by 4 wood strips spaced 16 inches o.c.

-- End of Section --

SECTION 07112

BITUMINOUS DAMPPROOFING
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 208	(1995) Cellulosic Fiber Insulating Board
ASTM C 728	(1997) Perlite Thermal Insulation Board
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 43	(1994) Coal Tar Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 226	(1997; Rev. A) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 227	(1997; Rev. A) Coal-Tar-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 449	(1989; R 1994) Asphalt Used in Dampproofing and Waterproofing
ASTM D 450	(1996) Coal-Tar Pitch Used in Roofing, Dampproofing and Waterproofing
ASTM D 4263	(1983; R 1993) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4479	(1993) Asphalt Roof Coatings - Asbestos Free

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926	Safety and Health Regulations for Construction
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1.2 DELIVERY AND STORAGE

Deliver materials in sealed containers bearing manufacturer's original labels. Labels shall include date of manufacture, contents of each container, performance standards that apply to the contents and recommended

shelf life.

1.3 SAFETY AND HEALTH REQUIREMENTS

If coal-tar pitch materials are used, the Contractor shall conform to all OSHA 29 CFR 1926 and General Industry Health Standards as well as state and local standards.

PART 2 PRODUCTS

2.1 ASPHALT

ASTM D 449, Type I or Type II.

2.2 ASPHALT PRIMER

ASTM D 41.

2.3 FIBROUS ASPHALT

ASTM D 4479, Type I for horizontal surfaces, Type II for vertical surfaces.

2.4 SURFACE PROTECTION

2.4.1 Saturated Felt

ASTM D 226, Asphalt Saturated, Type I, 15 pound; ASTM D 227, Coal-Tar Saturated.

2.4.2 Protection Board

Wood Fiber Board, ASTM C 208, or Perlite Board, ASTM C 728.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean concrete and masonry surfaces to receive dampproofing of foreign matter and loose particles. Apply dampproofing to clean dry surfaces. Moisture test in accordance with ASTM D 4263. If test indicates moisture, allow a minimum of 7 additional days after test completion for curing. If moisture still exists, redo test until substrate is dry.

3.2 APPLICATION

Use either hot-application or cold-application method. Use cold-application method in confined spaces where hot bitumen would be hazardous. Prime surfaces to receive asphaltic dampproofing unless recommended otherwise by dampproofing materials manufacturer. Apply dampproofing after priming coat is dry, but prior to any deterioration of primed surface, and when ambient temperature is above 40 degrees F.

3.2.1 Surface Priming

Prime surfaces to receive asphalt or fibrous asphalt dampproofing with asphalt primer. Apply primer when ambient temperature is above 40 degrees F and at rate of approximately one gallon per 100 square feet, fully covering entire surface to be dampproofed.

3.2.2 Hot-Application Method

Apply two mop coats of hot asphalt to surfaces. Apply mop coats uniformly using not less than 25 pounds of coal-tar pitch or 20 pounds of asphalt per 100 square feet for each coat. Do not heat asphalt above 450 degrees F. Do not heat coal tar pitch above 400 degrees F. Have kettlemen in attendance at all times during heating to ensure that maximum temperature specified is not exceeded. Apply hot asphalt bitumen or coal tar pitch and fully bond to primed surface. Provide finished surface that is smooth, lustrous, and impervious to moisture. Recoat dull or porous spots.

3.2.3 Cold-Application Method

Apply two coats of fibrous asphalt to surfaces to be dampproofed. Apply each coat uniformly using not less than one gallon fibrous asphalt per 50 square feet. Apply first coat by brush or spray to provide full bond with primed surface. Brush or spray second coat over thoroughly dry first coat unless recommended otherwise by dampproofing materials manufacturer. Provide finished surface that is of uniform thickness and impervious to moisture. Recoat porous areas.

-- End of Section --

SECTION 07212

MINERAL FIBER BLANKET INSULATION
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 665	(1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 930	(1992) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D 828	(1997) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM D 3833/D 3833M	(1996) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 84	(1998) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 136	(1996; Rev. A) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.134	Respiratory Protection
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(1997) Installation of Oil Burning Equipment
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NFPA 54 (1996) National Fuel Gas Code

NFPA 70 (1999) National Electrical Code

NFPA 211 (1996) Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM (1988) Puncture Test for Containerboard

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Blanket insulation

Accessories

SD-08 Manufacturer's Instructions

Insulation

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Smoking

Do not smoke during installation of blanket thermal insulation.

1.4.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLANKET INSULATION

ASTM C 665, Type III, blankets with reflective coverings; Class A, membrane-faced surface with a flame spread of 25 or less.

2.1.1 Thermal Resistance Value (R-VALUE)

As indicated

2.1.2 Recycled Materials

Provide Thermal Insulation containing recycled materials to the extent practicable, provided the material meets all other requirements of this section.

2.1.3 Prohibited Materials

Do not provide asbestos-containing materials.

2.2 BLOCKING

Wood, metal, unfaced mineral fiber blankets in accordance with ASTM C 665, Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E 136 for blocking around chimneys and heat producing devices.

2.3 ACCESSORIES

2.3.1 Adhesive

As recommended by the insulation manufacturer.

2.3.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Blocking at Attic Vents and Access Doors

Prior to installation of insulation, install permanent blocking to prevent insulation from slipping over, clogging, or restricting air flow through soffit vents at eaves. Install permanent blocking around attic trap doors.

Install permanent blocking to maintain accessibility to equipment or controls that require maintenance or adjustment.

3.1.2 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

- a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.
- b. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.
- c. Gas Fired Appliances: Clearances as required in NFPA 54.
- d. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking around flues and chimneys is not required when insulation blanket, including any attached vapor retarder, passed ASTM E 136, in addition to meeting all other requirements stipulated in Part 2. Blocking is also not required if the chimneys are certified by the manufacturer for use in contact with insulating materials.

3.2 INSTALLATION

3.2.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

3.2.1.1 Electrical wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.2.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Where insulation required is thicker than depth of joist, provide full width blankets to cover across top of joists. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

3.2.1.3 Installation at Bridging and Cross Bracing

Insulate at bridging and cross bracing by splitting blanket vertically at center and packing one half into each opening. Butt insulation at bridging and cross bracing; fill in bridged area with loose or scrap insulation.

3.2.1.4 Cold Climate Requirement

Place insulation to the outside of pipes.

3.2.1.5 Insulation Blanket with Affixed Vapor Retarder

Locate vapor retarder as indicated. Do not install blankets with affixed vapor retarders unless so specified. Unless the insulation manufacturer's instructions specifically recommend not to staple the flanges of the vapor retarder facing, staple flanges of vapor retarder at 6 inch intervals flush with face or set in the side of truss, joist, or stud. Avoid gaps and bulges in insulation and "fishmouth" in vapor retarders. Overlap both flanges when using face method. Seal joints and edges of vapor retarder with pressure sensitive tape. Stuff pieces of insulation into small cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, band joists, and headers. Cover these insulated cracks with vapor retarder material and tape all joints with pressure sensitive tape to provide air and vapor tightness.

3.2.1.6 Sizing of Blankets

Provide only full width blankets when insulating between trusses, joists, or studs. Size width of blankets for a snug fit where trusses, joists or studs are irregularly spaced.

3.2.1.7 Special Requirements for Ceilings

Place insulation under electrical wiring occurring across joists. Pack insulation into narrowly spaced framing. Do not block flow of air through soffit vents.

3.2.1.8 Access Panels and Doors

Affix blanket insulation to access panels greater than one square foot and access doors in insulated ceilings. Use insulation with same R-Value as that for floor or ceiling.

-- End of Section --

SECTION 07214

BOARD AND BLOCK INSULATION
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 165	(1995) Measuring Compressive Properties of Thermal Insulations
ASTM C 203	(1992) Breaking Load and Flexural Properties of Block-Type Thermal Insulation
ASTM C 272	(1991; R 1996) Water Absorption of Core Materials for Structural Sandwich Constructions
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM C 930	(1992) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 828	(1997) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM D 1621	(1994) Compressive Properties of Rigid Cellular Plastics

ASTM D 3833/D 3833M	(1996) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 84	(1998) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 136	(1996; Rev. A) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E 154	(1988; R 1993) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.134	Respiratory Protection
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(1997) Installation of Oil Burning Equipment
NFPA 54	(1996) National Fuel Gas Code
NFPA 70	(1999) National Electrical Code
NFPA 211	(1996) Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM	(1988) Puncture Test for Containerboard
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1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Block or board insulation; G

Vapor retarder

Pressure sensitive tape

Protection board or coating

Accessories

SD-08 Manufacturer's Instructions

Block or Board Insulation

Adhesive

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to the site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Other Safety Considerations

Consider safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLOCK OR BOARD INSULATION

Provide only thermal insulating materials recommended by manufacturer for type of application indicated.

2.1.1 Thermal Resistance

As indicated.

2.1.2 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all other requirements of this section.

2.1.3 Prohibited Materials

Do not provide materials containing more than one percent of asbestos.

2.2 VAPOR RETARDER AND DAMPPROOFING

2.2.1 Dampproofing for Masonry Cavity Walls

Bituminous material is specified in Section 07112, "Bituminous Dampproofing."

2.2.2 Vapor Retarder under Floor Slab

- a. Water vapor permeance: 0.2 Perm or less when tested in accordance with ASTM E 96.
- b. Puncture resistance: Maximum load no less than 40 pounds when tested according to ASTM E 154.

2.3 PRESSURE SENSITIVE TAPE

As recommended by manufacturer of vapor retarder and having a water vapor permeance rating of one perm or less when tested in accordance with ASTM D 3833/D 3833M.

2.4 PROTECTION BOARD OR COATING

As recommended by insulation manufacturer.

2.5 ACCESSORIES

2.5.1 Adhesive

As recommended by insulation manufacturer.

2.5.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Continuity of Insulation

Butt tightly against adjoining boards, studs, rafters, joists, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating any thermal bridges or voids.

3.2 INSTALLATION ON WALLS

3.2.1 Installation on Masonry Walls

Apply board directly to masonry with adhesive or fasteners as recommended by the insulation manufacturer. Fit between obstructions without impaling board on ties or anchors. Apply in parallel courses with joints breaking

midway over course below. Put ends in moderate contact with adjoining insulation without forcing. Cut and shape as required to fit around wall penetrations, projections or openings to accommodate conduit or other services. Seal around cut-outs with sealant. Install board in wall cavities so that it leaves at least a nominal one inch free air space outside of the insulation to allow for cavity drainage.

3.2.2 Adhesive Attachment to Concrete and Masonry Walls

Apply adhesive to wall and completely cover wall with insulation.

- a. As recommended by the insulation manufacturer.
- b. Use only full back method for pieces of one square foot or less.
- c. Butt all edges of insulation and seal edges with tape.

3.2.3 Protection Board or Coating

Install protection board or coating in accordance with manufacturer's instructions. Install protection over all exterior exposed insulation board and down to 1 foot below grade.

3.3 PERIMETER AND UNDER SLAB INSULATION

Install perimeter thermal insulation where heated spaces are adjacent to exterior walls or slab edges in slab-on-grade or floating-slab construction.

3.3.1 Insulation Under Slab

Provide insulation horizontally under entire slab on grade. Install insulation on top of vapor retarder and turn retarder up over the outside edge of insulation to top of slab.

3.3.2 Protection of Insulation

Protect insulation on vertical surfaces from damage during construction and back filling by application of protection board or coating. Do not leave installed vertical insulation unprotected overnight. Install protection over entire exposed exterior insulation board.

3.4 VAPOR RETARDER

Apply a continuous vapor retarder as indicated. Overlap all joints at least 6 inches and seal with pressure sensitive tape. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

-- End of Section --

SECTION 07216

LOOSE FILL THERMAL INSULATION
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 516	(1980; R 1996) Vermiculite Loose Fill Thermal Insulation
ASTM C 549	(1981; R 1995) Perlite Loose Fill Insulation
ASTM C 665	(1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 739	(1997) Cellulosic Fiber (Wood-Base) Loose-Fill Thermal Insulation
ASTM C 764	(1998) Mineral Fiber Loose-Fill Thermal Insulation
ASTM C 930	(1992) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM C 1015	(1984; R 1995) Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation
ASTM D 828	(1997) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM D 3833/D 3833M	(1996) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 84	(1998) Surface Burning Characteristics of Building Materials

ASTM E 96 (1995) Water Vapor Transmission of Materials

ASTM E 136 (1996; Rev. A) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C

CODE OF FEDERAL REGULATIONS (CFR)

16 CFR 1209 Interim Safety Standard for Cellulose Insulation

16 CFR 1404.4 Cellulose Insulation

29 CFR 1910.134 Respiratory Protection

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31 (1997) Installation of Oil Burning Equipment

NFPA 54 (1996) National Fuel Gas Code

NFPA 70 (1999) National Electrical Code

NFPA 211 (1996) Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM (1988) Puncture Test for Containerboard

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Loose fill insulation

SD-08 Manufacturer's Instructions

Loose Fill Insulation

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to the site in original sealed containers or packages, each bearing manufacturer's name and brand designation, referenced specification number, type, and class, as applicable; recommended method of installation (pneumatic or pouring); minimum net weight of insulation; coverage charts; R-values; and, for cellulose insulation, a label certifying that the product meets Consumer Product Safety Commission (CPSC)

Interim Safety Standard for Cellulose Insulation, 16 CFR 1209, and cautionary label regarding potential fire hazard as required in 16 CFR 1404.4.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Smoking

Do not smoke during installation of loose fill thermal insulation.

1.4.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C 930

PART 2 PRODUCTS

2.1 LOOSE FILL INSULATION

Provide loose fill insulation conforming to the following:

- a. Granular Mineral Loose Fill: ASTM C 516 type II vermiculite or ASTM C 549 types II or IV perlite.

2.1.1 Thermal Resistance Value(s) (R-Values)

The R-Value shall be as indicated. The R-value shall be the value the product achieves after settlement.

2.1.2 Recycled Material

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all the other requirements of this section.

2.1.3 Prohibited Materials

Do not provide asbestos-containing materials.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, verify that all areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify the Contracting Officer of such conditions.

3.2 INSTALLATION

3.2.1 Insulation

Install insulation using the amount (by weight) of material per square foot required to achieve the specified thermal resistance value.

3.2.2 Masonry Walls

Bring up granular insulation in not more than 2 foot lifts as the wall is constructed. Allow the insulation to assume its natural density as it is placed.

3.2.3 Electrical Wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.2.4 Cold Climate Requirement

Place insulation to the outside of all pipes.

-- End of Section --

SECTION 07240

EXTERIOR INSULATION AND FINISH SYSTEMS
03/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS

ANSI/ASCE 7-95 (1995) Minimum Design Loads for Buildings and other Structures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM C 67	(1997) Sampling and Testing Brick and Structural Clay products
ASTM C 150	(1999) Portland Cement
ASTM C 473	(1997) Physical Testing of Gypsum Panel Products
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 847	1995 Metal Lath
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 1177/C 1177M	(1996) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1185	(1996) Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and siding shingles, and Clapboards
ASTM C 1186	(1996; Rev. A) Flat Non-Asbestos Fiber-Cement Sheets
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 2247	(1994) Testing Water Resistance of Coatings in 100% Relative Humidity

ASTM D 3273	(1994) Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
ASTM E 84	(1998) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 119	(1995a) Fire Tests of Building Construction and Materials
ASTM E 136	(1998) Behavior of Materials in Vertical Tube Furnace at 750 Degrees C
ASTM E 330	(1997) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 695	(1979; R 1997) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
ASTM E 1105	(1996) Field Determination of Water Penetration of installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) with and Without Water for Exposure of Nonmetallic Materials

EXTERIOR INSULATION MANUFACTURERS ASSOCIATION (EIMA)

EIMA 101.01	(1995) Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EIFS), Class PB.
EIMA 101.86	(1987; R 1994) Resistance of Exterior Insulation and Finish Systems, Class PB, to the Effects of Rapid Deformation (Impact)
EIMA 105.01	(1995) Alkali Resistance of Glass Fiber Reinforcing Mesh for Use in Exterior Insulation and Finish Systems

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

UBC 26-4 Evaluation of Flammability Characteristics
of Exterior, Nonload-Bearing Wall Panel
Assemblies using Foam Plastic Insulation

UBC 26-9 Evaluation of Flammability Characteristics
of Exterior Nonload-Bearing Wall
Assemblies Containing Combustible
Components using Intermediate-Scale,
Multistory Test Apparatus

NATIONAL FIRE PROTECTION ASSOCIATION, INC. (NFPA)

NFPA 268 (1996) Determining Ignitability of
Exterior Wall Assemblies Using a Radiant
Heat Energy Source

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal
Procedures."

SD-02 Shop Drawings

Shop drawings; G

Show wall layout, construction and expansion joints, decorative
grooves, layout of sheathing board, thermal insulation board, and
reinforcement mesh and strip reinforcing fabric; joint and
flashing details; types and location of fasteners; and details at ,
roof, , , .

SD-03 Product Data

Sheathing board

Thermal insulation

Adhesive

Mechanical anchors

Accessories

Base coat

Portland cement

Reinforcing fabric

Finish coat

Sealant

Primer

Bond breaker

Backer Rod

Warranty

Include joint and other details, such as end conditions, corners, windows, parapet. Include shelf life and recommended cleaning solvents in data for sealants. Include material safety data sheets (MSDS) for all components of the EIFS. The MSDS shall be available at the job site.

SD-04 Samples

EIFS Components; G

12 by 24 inches, on sheathing board, including finish color and texture, typical joints and sealant.

Mock-up of EIFS; G

Complete wall sample installation 1 ft high by 1 ft wide, including typical control joints. Control joints to be filled with sealant of type, manufacturer, and color selected. Construct sample installation at manufacturer's plant.

SD-05 Design Data

Wind load Calculations

Moisture analysis Calculations

SD-06 Test Reports

Abrasion resistance

Accelerated weathering

Impact resistance

Mildew resistance

Salt spray resistance

Water vapor transmission

Absorption-freeze-thaw

Flame spread

Water penetration

Water resistance

Full scale or immediate scale fire test

Flame Spread

Radiant heat

Fire Endurance

Wind load

SD-07 Certificates

Qualification of Installer

Qualification of Sealant Applicator

Certify that EIFS installer meets requirements specified under paragraph "Qualification of Installer," and that sealant applicator is approved by the EIFS Manufacturer.

EIFS Inspection Check List; G

Submit filled-out inspection check list as required in paragraph "Quality Control," certifying that the installation of critical items meets the requirements of this specification.

SD-08 Manufacturer's Instructions

Substrate

Installation

Manufacturer's standard printed instructions for the installation of the EIFS. Include requirements for condition and preparation of substrate, installation of EIFS, and requirements for sealants and sealing.

SD-10 Operation and Maintenance Data

EIFS

Include detailed finish repair procedures and information regarding compatibility of sealants with base and finish coatings.

1.3 DESCRIPTION OF WORK

The exterior insulation and finish system (EIFS) shall be a job-fabricated exterior wall covering consisting of insulation, reinforcing mesh, base coat, finish coat, and accessories. The system components shall be compatible with each other and with the substrate and be products of, or approved by, a single manufacturer regularly engaged in furnishing exterior insulation and finish systems. All materials shall be installed by an applicator approved by the system manufacturer. EIFS shall be Class PM and

shall have color and finish as indicated on the drawings.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Installer

Use only EIFS Installer trained and approved by the EIFS manufacturer and having successfully installed at least five installations at or near the size and complexity of this project.

1.4.1.1 Qualification of Sealant Applicator

Use only sealant applicators trained and approved by the sealant manufacturer for sealant application to EIFS

1.4.2 Pre-Installation Conference

After approval of submittals and before commencing any work on the EIF system, including installation of any sheathing board, insulation, and associated work, the Contracting Officer will hold a pre-installation conference to review:

- a. Drawings and specifications;
- b. Procedure for on site inspection and acceptance of EIFS substrate and pertinent details;
- c. Contractor's plan for coordination of work of the various trades involved in providing EIF system and other components;
- d. Inspection procedures; and
- e. Safety requirements.

Pre-installation conference shall be attended by the Contractor, and all personnel directly responsible for installation of the EIF system, including sealant applicator, and personnel responsible for related work, such as flashing and sheet metal, windows and doors, and a representative of the EIFS manufacturer. Before beginning EIFS work, the contractor shall confirm in writing the resolution of conflicts among those attending the preinstallation conference.

1.4.3 EIFS Components

The EIF System shall consist of sheathing, insulation board, reinforcement mesh, base coat, finish coat, adhesive and mechanical fasteners as applicable

1.4.4 Mock-up of EIFS

Complete wall sample installation 1 ft high by 1 ft wide, including typical control joints. Control joints to be filled with sealant of type, manufacturer, and color selected. Construct sample installation at manufacturer's plant. Build mock-up to comply with the following

requirements, using materials indicated for the completed work:

- a. Locate mock-up in the location and size indicated .
- b. Demonstrate the proposed range of color, texture, thickness, insulation, and workmanship.
- c. Obtain Contracting Officer's written approval of mock-up before starting fabrication of work.
- d. Maintain mock-up during construction as a standard for judging the completed work by protecting them from weather and construction activities.

1.5 EIFS SYSTEMS PERFORMANCE REQUIREMENTS

The systems and component performance tests listed below shall be conducted either on the job site or at the manufacturer's plant. Where a wall system or component of similar type, size, and design as specified for this project has been previously tested under the condition specified herein, the resulting test reports may be submitted in lieu of the tests.

1.5.1 Water Penetration and Wind Load

1.5.1.1 Full Scale Test Specimen

Construct test specimen 1 ft wide and 1 ft high of EIFS to incorporate typical conditions. For purposes of wind load testing. All materials, components, and substrate (studs, etc.), including fasteners and sealants, shall be as proposed in the construction.

1.5.1.2 Water Penetration Test Procedure

Conduct in accordance with ASTM E 1105 at a differential static test pressure of 20 percent of the inward acting design wind pressure, but not less than 6.4 psf.

1.5.1.3 Water Penetration Performance Requirement

No uncontrolled water leakage.

1.5.1.4 Wind Load Test Procedure

Conduct in accordance with ASTM E 330.

1.5.1.5 Wind Load Performance Requirement

No permanent deformation, delamination, or other deterioration at 1.5 times the design wind load in accordance with ANSI/ASCE 7-95, both positive and negative.

1.5.2 Full-Scale or Immediate Scale Fire Test

Conduct wall fire test using apparatus, specimen, performance criteria, and

procedure in accordance with UBC 26-4. The specimen shall include the complete system. At the option of the contractor, UBC 26-9, Intermediate-Scale Test may be substituted in lieu of the Full-Scale Multi Story Fire test.

1.5.2.1 Full-Scale or Immediate-Scale Fire Performance Requirement

- a. No vertical spread of flame within core of the panel from one story to the next.
- b. No flame propagation over the exterior surface.
- c. No vertical flame spread over the interior surface from one story to the next.
- d. No significant lateral spread of flame from the compartment of fire origin to adjacent spaces.

1.6 EIFS COMPONENT PERFORMANCE REQUIREMENTS

1.6.1 Flame Spread

Flame spread rating for insulation board, Base coat, reinforcing fabric, and finish coat, after 28 days curing shall be 25 when tested in accordance with ASTM E 84.

1.6.2 Radiant Heat

The system shall be tested in accordance with NFPA 268 with no ignition during the 20-minute period

1.6.3 Fire Endurance

The system shall be tested according to ASTM E 119 with no effect on fire resistance rating of the wall assembly.

1.6.4 Moisture Analysis

Perform a job specific vapor vapor transmission analysis based on project specific climate and specified wall components and materials. Indicate the temperatures and relative humidity for the inside and outside the building; a complete listing of the building components, their thickness, thermal resistance and permeance, as well as building location and use. If a mathematical model was used for the analysis, include the name of the model and the supplier/developer.

1.6.5 Impact Resistance

1.6.5.1 Hemispherical Head Test

Test 28 day cured specimen of PB EIFS in accordance with EIMA 101.86. No broken reinforcing fabric at an impact of 80 psi.

1.6.5.2 Finish Coat

The finish coat, as applied to the system, shall meet the requirements in Table 1. Unless otherwise specified, the test specimen shall consist of reinforcement, base coat, and finish coat applied in accordance with manufacturer's printed recommendations to the insulation board to be used on the building. For mildew resistance, only the finish coat is applied onto glass slides for testing. These specimen shall be suitably sized for the apparatus used and be allowed to cure for a minimum of 28 days prior to testing.

TABLE 1

<u>TES</u>	<u>METHO</u>	<u>RESULTS</u>
Abrasion resistance	ASTM D 968	500 liters - very slight smoothing - no deleterious effects.
Accelerated weathering	ASTM G 23	2000 hours - no deterioration.
Mildew resistance	ASTM D 3273	No growth supported during 28 day exposure.
Salt spray resistance	ASTM B 117	After 300 hours exposure, no deleterious effects, such as chalking and chalking and fading.
Water Resistance	ASTM D 2247	After 14 days no cracking, checking, crazing erosion, blistering, peeling, or delamination
Water vapor transmission (Water vapor permeance)	ASTM E 96 Water Method	37 perm(s) (grains/hour/square foot per inch of mercury vapor pressure.)
Absorption-freeze-thaw PB Systems	EIMA 101.01	After 60 cycles of freezing and thawing, no cracking, checking, and negligible weight gain.
Absorption-freeze-thaw PM Systems	ASTM C 67	After 50 cycles of freezing and thawing, no cracking, hecking, and negligible weight gain.

1.7 DELIVERY AND STORAGE

Deliver materials to job site in original unopened packages, marked with manufacturer's name, brand name, and description of contents. Store materials off the ground and in accordance with the manufacturer's recommendations in a clean, dry, well-ventilated area. Protect stored materials from rain, sunlight, and excessive heat. Keep coating materials which would be damaged by freezing at a temperature not less than 40 degrees F. Do not expose insulation board to flame or other ignition sources.

1.8 ENVIRONMENTAL CONDITIONS

- a. Do not apply EIFS during inclement weather unless appropriate protection is provided. Protect installed materials from inclement weather until they are dry.
- b. Apply sealants and wet materials only at ambient temperatures of 40 degrees F or above and rising, unless supplemental heat is provided. Maintain this temperature for a minimum of 24 hours after application of each liquid component.
- c. Do not leave insulation board exposed to sunlight after installation.

1.9 WARRANTY

Furnish manufacturer's standard warranty for the EIFS. Warranty shall run directly to Government and cover a period of not less than 5 years from date Government accepted the work.

PART 2 PRODUCTS

2.1 COMPATIBILITY

Provide all materials compatible with each other and with the substrate, and as recommended by EIFS manufacturer.

2.2 SHEATHING BOARD

2.2.1 Fiber Reinforced Cement Sheathing Board

- a. Meet ASTM C 1186, Type B, Grade II.
- b. Non-combustible per ASTM E 136.
- c. Nail Pull Resistance: No less than 535 N when tested in accordance with ASTM C 473.
- d. Thickness no less than 1/2 in.
- e. Water Absorption not to exceed 17 percent when tested in accordance with ASTM C 1185.

2.2.2 Glass Mat Gypsum Sheathing Board

- a. Conform to ASTM C 1177/C 1177M.
- b. Nail Pull Resistance: No less than 120 lb when tested in accordance with ASTM C 473.

2.3 ADHESIVE

Manufacturer's standard product, including primer as required, and shall be compatible with substrate, insulation board, and reinforcing mesh to which the system is applied

2.4 MECHANICAL ANCHORS

Corrosion resistant and as approved by EIFS manufacturer. Select fastener type and pattern based on applicable wind loads and substrate into which fastener will be attached, to provide the necessary pull-out, tensile, and shear strengths.

2.5 THERMAL INSULATION

2.5.1 Manufacturer's Recommendations

Provide only thermal insulation recommended by the EIFS manufacturer for the type of application intended.

2.5.2 Insulation Board

Insulation shall be standard product of manufacturer and shall be compatible with other systems components. Boards shall be factory marked individually with the manufacturer's name or trade mark, the material specification number, the R-value at 75 degree F, and thickness. No layer of Insulation shall be less than 3/4 in thick. Insulation for PM systems and insulation extending below grade shall be restricted to a low water vapor permeability grade of extruded polystyrene type IV or X.

- a. Thermal resistance: As indicated
- b. Insulating material: ASTM C 578 Type I or IV, as recommended by the EIFS manufacturer and treated to be compatible with other EIFS components. Age insulation a minimum of 6 weeks prior to cutting from block form installation.

2.5.3 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided the material meets all other requirements of this section.

2.6 BASE COAT

Manufacturer's standard product.

2.7 PORTLAND CEMENT

Conform to ASTM C 150, Type I or II as required, fresh and free of lumps, and approved by the systems manufacturer.

2.8 REINFORCING FABRIC

Reinforcing fabric mesh shall be alkali-resistant, balanced, open weave, glass fiber fabric made from twisted multi-end strands specifically treated for compatibility with the other system materials, and comply with EIMA 105.01 and as recommended by EIFS manufacturer.

2.9 FINISH COAT

Manufacturer's standard product conforming to the requirements in Table 1.

2.10 PRIMER

Non-staining, quick-drying type recommended by sealant manufacturer and EIFS manufacturer.

2.11 ACCESSORIES

Conform to recommendations of EIFS manufacturer, including trim, edging, anchors, expansion joints. All metal items and fasteners to be corrosion resistant.

2.12 SEALANT

Non-staining, quick-drying type meeting ASTM C 920, Class 25, compatible with the finish system type and grade, and recommended by both the sealant manufacturer and EIFS manufacturer.

2.13 BOND BREAKER

As required by EIFS manufacturer and recommended by sealant manufacturer and EIFS manufacturer.

2.14 BACKER ROD

Closed cell polyethylene free from oil or other staining elements and as recommended by sealant manufacturer and EIFS manufacturer. Do not use absorptive materials as backer rod. The backer rod should be sized 25 percent larger than the width of the joint.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

3.1.1 Field Inspection

The contractor shall establish and maintain an inspection procedure to assure compliance of the installed EIFS with contract requirements. Work found to be not in compliance shall be removed and replaced or corrected in an approved manner. The inspection shall, at the minimum, include all applicable items enumerated on the attached check

list. The inspector shall initial all applicable items, sign the check list, and submit it to the Contracting Officer at the completion of the EIFS erection.

3.2 EXAMINATION

Examine substrate and existing conditions to determine that the EIFS can be installed as required by the EIFS manufacturer and that all work related to the EIFS is properly coordinated. Surface shall be sound and free of oil, loose materials or protrusions which will interfere with the system installation. If deficiencies are found, notify the Contracting Officer and do not proceed with installation until the deficiencies are corrected. The substrate shall be plane, with no deviation greater than 1/4 inch when tested with a 10 foot straightedge. Determine flatness, plumbness, and any other conditions for conformance to manufacturer's instructions.

3.3 SURFACE PREPARATION

Prepare existing surfaces for application of the EIFS to meet flatness tolerances and surface preparation according to manufacturer's installation instructions. Provide clean surfaces free of oil and loose material without protrusions adversely affecting the installation of the insulation board. Due to substrate conditions or as recommended by the system manufacturer, a primer may be required. The primer shall be mixed and applied per the manufacturer's instructions. Use masking tape to protect areas adjacent to the EIFS to prevent base or finish coat to be applied to areas not intended to be covered with the EIFS.

3.4 INSTALLATION

Install EIFS as indicated and in conformance with the EIFS manufacturer's installation instructions except as otherwise specified, and in accordance with the shop drawings showing details and construction and expansion joint locations. EIFS shall be installed only by an applicator trained and approved by the EIFS manufacturer.

3.4.1 Sheathing Board

Stagger vertical joints to provide full and even support for insulation. Do not align sheathing board joints with wall openings. Attach sheathing board to wood studs with drywall screws. Edges and ends of boards shall be butted snugly with vertical joints staggered to provide full and even support for the insulation. Place fasteners sufficiently close to support imposed loads, but not more than:

- a. 8 inches apart on each supporting stud

Space fasteners more closely when required for negative wind load resistance.

3.4.2 Insulation Board

Unless otherwise specified by the system manufacturer, place the long edge

horizontally from level base line. Stagger vertical joints and interlock at corners. Butt joints tightly. Provide flush surfaces at joints. Offset insulation board joints from joints in sheathing by at least 8 inches.

Use L-shaped insulation board pieces at corners of openings. Joints of insulation shall be butted tightly. Surfaces of adjacent insulation boards shall be flush at joints. Gaps greater than 1/16 inch between the insulation boards shall be filled with slivers of insulation. Joints of insulation shall be offset from substrate joints by at least 8 inches. Uneven board surfaces with irregularities projecting more than 1/16 inch shall be rasped in accordance with the manufacturer's instructions to produce an even surface. Attach insulation board as recommended by manufacturer. The adhered insulation board shall be allowed to remain undisturbed for 24 hours prior to proceeding with the installation of the base coat/reinforcing mesh, or longer if necessary for the adhesive to dry.

However, do not leave insulation board exposed longer than recommended by insulation manufacturer.

3.4.2.1 Mechanically Fastened Insulation Boards (Optional)

Fasten with manufacturer's standard anchors, spaced as recommended by manufacturer, but not more than 2 feet horizontally and vertically.

3.4.2.2 Adhesively Fastened Insulation Boards

Apply insulation board using adhesive spread with a notched trowel to the back of the insulation boards in accordance with the manufacturer's instructions.

3.4.3 Base Coat and Reinforcing Fabric Mesh,

3.4.3.1 Class PB Systems

Mix base coat in accordance with the manufacturer's instructions and apply to insulated wall surfaces to the thickness specified by the system manufacturer. The reinforcing fabric mesh shall be troweled into the wet base coat material. Fully embed the mesh in the base coat. When properly worked-in, the pattern of the reinforcing fabric mesh shall not be visible.

Diagonal reinforcement shall be provided at opening corners. Back-rap all terminations of the EIFS. The reinforcing fabric mesh shall be overlapped a minimum of 2 inches on previously installed mesh, or butted, in accordance with the manufacturer's instructions. The adhered insulation board shall be allowed to dry for 24 hours, or longer if necessary, prior to proceeding with the installation of the base coat/reinforcing fabric mesh. Install reinforcing fabric in accordance with and manufacturer's instructions. Provide diagonal reinforcement at opening corners. Provide full back wrapping. Provide any other reinforcement recommended by EIFS manufacturer. Assure that all reinforcing fabric is fully bedded in the base coat material.

3.4.4 Finish Coat

Apply and level finish coat in one operation. Obtain final texture by trowels, floats, or by spray application as necessary to achieve the required finish matching approved sample installation. Apply the finish

coat to the dry base coat maintaining a wet edge at all times to obtain a uniform appearance. The thickness of the finish coat shall be in accordance with the system manufacturer's current published instructions. Apply finish coat so that it does not cover surfaces to which joint sealants are to be applied. The base coat/reinforcing mesh must be allowed to dry a minimum of 24 hours prior to the application of the finish coat. Surface irregularities in the base coat, such as trowel marks, board lines, reinforcing mesh laps, etc., shall be corrected prior to application of the finish coat. Do not apply finish coat to areas which will be in contact with sealants.

3.5 JOINT SEALING

Seal exterior insulation and finish system at openings as recommended by the system manufacturer. Apply sealant only to the base coat. Do not apply sealant to the finish coat.

3.5.1 Surface Preparation, Backer Rod, and Primer

Immediately prior to application, remove loose matter from joint. Ensure that joint is dry and free of paint, finish coat, or other foreign matter.

Install backer rod. Apply primer as required by sealant and EIFS manufacturer. Check that joint width is as shown on drawings but in no case shall it be less than 0.5 inch for perimeter seals and 0.75 inch for expansion joints. The width shall not be less than 4 times the anticipated movement. Check sealant manufacturer's recommendations regarding proper width to depth ratio.

3.5.2 Sealant

Apply sealant in accordance with sealant manufacturer's instructions with gun having nozzle that fits joint width. Do not use sealant that has exceeded shelf life or can not be discharged in a continuous flow. Completely fill the joint solidly with sealant without air pockets so that full contact is made with both sides of the joint. Tool sealant with a round instrument that provides a concave profile and a uniformly smooth and wrinkle free sealant surface. Do not wet tool the joint with soap, water, or any other liquid tooling aid. Do not apply sealant until all EIFS coatings are fully dry. During inclement weather, protect the joints until sealant application. Use particular caution in sealing joints between window and door frames and the EIFS wall and at all other wall penetrations. Clean all surfaces to remove excess sealant.

3.6 CLEANUP

Upon completion, remove all scaffolding, equipment, materials and debris from site. Remove all temporary protection installed to facilitate installation of EIFS.

3.7 EIFS INSPECTION CHECK LIST

The contractor shall establish and maintain an inspection procedure to assure compliance of the installed EIFS with contract requirements. Work found to be not in compliance shall be removed and replaced or corrected in

an approved manner. Inspection shall include, but not be limited to the following:

CHECK LIST

<u>Ite</u>	<u>Descriptio</u>	<u>Approved</u>
a.	Materials are handled and stored correctly.	_____
b.	Environmental conditions are within specified limits, including temperature not below 4 degrees C (40 degrees F), and the work is protected from the elements as required.	_____
c.	Preparation and installation is performed by qualified personnel using the correct tools.	_____
d.	Adjacent areas to which EIFS is not to be applied (such as on window and door frames) are protected with masking tape.	_____
e.	Control, expansion and aesthetic joints are installed as indicated or recommended. Accessories are properly installed.	_____
f.	Substrate is in-plane, properly attached, clean, dry, and free of contaminants. Concrete substrate is free of efflorescence.	_____
g.	Materials are mixed thoroughly and in proper proportions.	_____
h.	Adhesive is applied in sufficient quantity with proper-size notched trowel.	_____
i.	Mechanical attachments have proper spacing, layout and fastener depth.	_____
j.	Insulation boards are tightly abutted, in running bond pattern, with joints staggered with the sheathing, board corners interlocked, L-shaped boards around openings, edges free of adhesive, and provision for joints. Gaps are filled and surfaces rasped.	_____
k.	Insulation adhesive must be allowed to dry (a minimum of 24-hours) prior to the application of the finish coat.	_____
l.	Reinforcing fabric mesh is properly back-wrapped at terminations.	_____
m.	Reinforcing fabric mesh is fully embedded and properly placed. Corners are reinforced. Openings are diagonally reinforced. Mesh overlaps minimum 65 mm (2-1/2 inches).	_____
n.	Base coat thickness is within specified limits.	_____

CHECK LIST

<u>Ite</u>	<u>Descriptio</u>	<u>Approved</u>
o.	The base coat/reinforcing fabric mesh must be allowed to dry (a minimum of 24-hours) prior to the application of the finish coat.	_____
p.	Finish coat is applied with sufficient number of personnel and stopped at suitable points. Floats and methods of texturing are uniform.	_____
q.	Flashings and joint sealant are applied at time specified by the manufacturer.	_____
r.	All joints are properly sealed in their entire length.	_____
-- End of Section --		

SECTION 07600

FLASHING AND SHEET METAL

09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 653/A 653M	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 32	(1996) Solder Metal
ASTM B 69	(1998) Rolled Zinc
ASTM B 101	(1996) Lead-Coated Copper Sheet and Strip for Building Construction
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221M	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 1784	(1997) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

ASTM D 4586 (1993) Asphalt Roof Cement, Asbestos-Free

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.2 (1997) Structural Welding Code Aluminum

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION,
INC. (SMACNA)

SMACNA ASMM (1993) Architectural Sheet Metal Manual

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Covering on flat, sloped, or curved surfaces; G

Fascias; G

Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

SD-11 Closeout Submittals

Quality Control Plan

Submit for sheet metal work in accordance with paragraph entitled "Field Quality Control."

1.3 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. These accessories shall be made of the same materials as the items to which they are applied. Fabricate sheet metal

items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Sheet metal items shall have mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used except as follows:

2.1.1 Exposed Sheet Metal Items

Shall be of the same material. The following items shall be considered as exposed sheet metal: fascias, and related accessories.

2.1.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such items.

2.1.3 Steel Sheet, Zinc-Coated (Galvanized)

ASTM A 653/A 653M.

2.1.3.1 Finish

Exposed exterior items of zinc-coated steel sheet shall have a baked-on, factory-applied color coating of polyvinylidene fluoride or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Finish coating dry-film thickness shall be 0.8 to 1.3 mils and color shall be medium bronze.

2.1.4 Stainless Steel

ASTM A 167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.1.5 Solder

ASTM B 32.

2.1.6 Bituminous Plastic Cement

ASTM D 4586, Type I.

2.1.7 Building Paper

Uncreped, reinforced, 20 lb per inch dry tensile strength, 16 hour minimum water resistance.

2.1.8 Asphalt Primer

ASTM D 41.

2.1.9 Through-Wall Flashing

Through-wall flashing for masonry is specified in Section 04200, "Unit Masonry."

2.1.1.10 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials. Iron or steel fastener shall not be used where the possibility of water exposure exists.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Requirements

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA ASMM, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.2 Workmanship

Make lines, arrises, and angles sharp and true. Free exposed surfaces from visible wave, warp, and buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

3.1.3 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inches. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inches on centers and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work. Sleepers and nailing strips are specified in Section 06100, "Rough Carpentry."

3.1.4 Cleats

Provide cleats for sheet metal 18 inches and over in width. Space cleats evenly not over 12 inches on centers unless otherwise specified or indicated. Unless otherwise specified, cleats shall be not less than 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nail heads. Lock the other end into the seam. Pretin cleats for soldered seams.

3.1.5 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide

compatible washers where required to protect surface of sheet metal and to provide a watertight connection.

3.1.6 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.6.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

3.1.6.2 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inches.

3.1.6.3 Loose-Lock Expansion Seams

Not less than 3 inches wide; provide minimum one inch movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 1/8 inch thick bed. Sealants are specified in Section 07920, "Joint Sealants."

3.1.6.4 Flat Seams

Make seams in the direction of the flow.

3.1.7 Soldering

Where soldering is specified, it shall apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items.

3.1.7.1 Edges

Pretin edges of sheet metals before soldering. Slowly solder with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pretinned. Solder immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a solution of washing soda in water and rinsed with clean water. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants.

Do not solder aluminum.

3.1.8 Protection from Contact with Dissimilar Materials

3.1.8.1 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.8.2 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.9 Expansion and Contraction

Provide expansion and contraction joints at not more than 32 foot intervals for aluminum and at not more than 40 foot intervals for other metals. Where the distance between the last expansion joint and the end of the continuous run is more than half the required interval, an additional joint shall be provided. Space joints evenly. Join extruded aluminum gravel stops and fascias by expansion and contraction joints spaced not more than 12 feet apart.

3.1.10 Fascias

Prefabricate in the shapes and sizes indicated and in lengths not less than 8 feet. Extend flange at least 4 inches onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascias after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of fascias on both sides with an asphalt primer. Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 1.5 inches long spaced not more than 3 inches on centers, in two staggered rows.

3.1.10.1 Edge Strip

Hook the lower edge of fascias at least 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inches maximum on centers. Where fastening is made to concrete or masonry, use screws spaced 12 inches on centers driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 1/16 inch thick compatible spacer or washers.

3.1.10.2 Joints

Leave open the section ends of gravel stops and fascias 1/4 inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4 inches set laps in plastic cement. Face nailing will not be permitted. Install prefabricated aluminum gravel stops and fascias in accordance with the manufacturer's printed instructions and details.

3.1.11 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, dormers and small decks with metal sheets of the material used for flashing; maximum size of sheets, 16 by 18 inches. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams and fill with sealer as recommended by aluminum manufacturer. Provide an underlayment of building

paper for all sheet metal covering.

3.2 PAINTING

Field-paint sheet metal for separation of dissimilar materials. Finish painting is specified in Section 09900, "Paints and Coatings."

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Work not in compliance with the contract shall be promptly removed and replaced or corrected. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.
- b. Verification of compliance before, during, and after installation.
- c. Inspection of sheet metalwork, for proper size and thickness, fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Stainless Steel, Inch	Zinc- Coated Steel, U.S. Std. Gage
Covering on minor flat, pitched or curved surfaces.....	.018	-
Fascias:		
Sheets, smooth.....	.018	24
Edge strip.....	.025	-

TABLE II. SHEET METAL JOINTS
TYPE OF JOINT

Item Designa- tion	Copper, Terne- Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Flashings			
Edge strip	Butt	Butt	- - -

-- End of Section --

SECTION 07611

STEEL STANDING SEAM ROOFING
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-673 (1986) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1997; Rev. A) Carbon Structural Steel

ASTM A 366/A 366M (1997) Commercial Quality Steel (CS) Sheet, Carbon (0.15 Maximum Percent), Cold-Rolled

ASTM A 570/A 570M (1997) Structural Steel, Sheet and Strip, Carbon, Hot-Rolled

ASTM A 607 (1998) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled

ASTM A 653/A 653M (1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 792/A 792M (1997; Rev. A) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

ASTM B 117 (1997) Operating Salt Spray (Fog) Apparatus

ASTM D 226 (1997; Rev. A) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

ASTM D 522 (1993; Rev. A) Mandrel Bend Test of Attached Organic Coatings

ASTM D 523 (1989; R 1994) Specular Gloss

ASTM D 714 (1987; R 1994) Evaluating Degree of Blistering of Paints

ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1993) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1997) Water Resistance of Coatings in 100 Percent Relative Humidity
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM E 84	(1998) Surface Burning Characteristics of Building Materials
ASTM E 1592	(1995) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) with and Without Water for Exposure of Nonmetallic Materials

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION,
INC. (SMACNA)

SMACNA ASMM	(1993) Architectural Sheet Metal Manual
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1.2 DEFINITIONS

1.2.1 Field-Formed Seam

Seams of panels so configured that when adjacent sheets are installed the seam is sealed utilizing mechanical or hand seamers. Crimped (45 degree bend), roll formed (180 degree bend), double roll formed (2 - 180 degree bends), and roll and lock systems are types of field-formed seam systems.

1.2.2 Snap Together Seam

Panels so configured that the male and female portions of the seam interlock through the application of foot pressure or tamping with a mallet. Snap-on cap configurations are a type of snap together system.

1.2.3 Pre-Formed

Formed to the final, less field-formed seam, profile and configuration in the factory.

1.2.4 Field-Formed

Formed to the final, less field-formed seam, profile and configuration at the site of work prior to installation.

1.2.5 Roofing System

The roofing system is defined as the assembly of roofing components, including roofing panels, flashing, fasteners, and accessories which, when assembled properly result in a watertight installation.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

- a. Panels shall be continuous lengths up to manufacturer's standard longest lengths, with no joints or seams, except where indicated or specified. Ribs of adjoining sheets shall be in continuous contact from eave to ridge. Individual panels of snap together type systems shall be removable for replacement of damaged material.
- b. There shall be no exposed or penetrating fasteners except where shown on approved shop drawings. Fasteners into steel shall be stainless steel, zinc cast head, or cadmium plated steel screws inserted into predrilled holes. There shall be a minimum of two fasteners per clip. Single fasteners will be allowed when supporting structural members are prepunched or predrilled.
- c. Snap together type systems shall have a capillary break and a positive side lap locking device. Field-formed seam type systems shall be mechanically locked closed by the manufacturer's locking tool. The seam shall include a continuous factory applied sealant when required by the manufacturer to withstand the wind loads specified.
- d. Roof panel anchor clips shall be concealed and designed to allow for longitudinal thermal movement of the panels, except where specific fixed points are indicated. Provide for lateral thermal movement in panel configuration or with clips designed for lateral and longitudinal movement.

1.3.2 Design Conditions

The system shall be designed to resist positive and negative loads specified herein in accordance with the AISI SG-673. Panels shall support walking loads without permanent distortion or telegraphing of the structural supports.

1.3.2.1 Wind Uplift

The design uplift pressures for the roof system shall be computed and applied using a basic wind speed of 92 miles per hour (mph). Roof system and attachments shall resist the following wind loads, in pounds per square

foot (psf):

	<u>Negative</u>
a. At eaves	45
b. At rakes	45
c. At ridge	45
d. At building corners	45
e. At central areas	45

The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly, and multiplied by the appropriate factor of safety, as follows:

- a. Single fastener in a connection: 3.0
- b. Two or more fasteners in each connection: 2.25

1.3.2.2 Roof Live Loads

Loads shall be applied on the horizontal projection of the roof structure. The minimum roof design live load shall be 20 psf.

1.3.2.3 Thermal Movement

System shall be capable of withstanding thermal movement based on a temperature range of 10 degrees F below zero degrees F and 140 degrees F.

1.3.2.4 Deflection

Panels shall be capable of supporting design loads between unsupported spans with deflection of not greater than $L/180$ of the span.

1.3.3 Structural Performance

The structural performance test methods and requirements of the Standing Seam Roofing Systems (SSRS) shall be in accordance with ASTM E 1592.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Roofing; G

Submit roofing drawings to supplement the instructions and diagrams. Drawings shall include design and erection drawings

containing an isometric view of the roof showing the design uplift pressures and dimensions of edge, ridge and corner zones; and show typical and special conditions including flashings, materials and thickness, dimensions, fixing lines, anchoring methods, sealant locations, sealant tape locations, fastener layout, sizes, and spacing, terminations, penetrations, attachments, and provisions for thermal movement. Details of installation shall be in accordance with the manufacturer's Standard Instructions and details or the SMACNA ASMM. Prior to submitting shop drawings, have drawings reviewed and approved by the manufacturer's technical engineering department.

SD-03 Product Data

Roofing panels; G

Attachment clips

Closures

Accessories

Fasteners

Sealants

Sample warranty certificate; G

Submit for materials to be provided. Submit data sufficient to indicate conformance to specified requirements.

SD-04 Samples

Roofing panel

Submit a 12 inch long by full width section of typical panel.

For color selection, submit 2 by 4 inch metal samples in color, finish and texture specified .

Accessories

Submit each type of accessory item used in the project including, but not limited to each type of anchor clip, closure, fastener, and leg clamp.

Sealants

Intermediate Support Section

Submit full size samples of each intermediate support section, 12 inches long.

SD-05 Design Data

Design calculations

SD-06 Test Reports

Field Inspection; G

Submit manufacturer's technical representative's field inspection reports as specified in paragraph entitled "Manufacturer's Field Inspection."

Structural performance tests

Finish tests

SD-07 Certificates

Manufacturer's Technical Representative's Qualifications

Statement of Installer's Qualifications

Submit documentation from roofing manufacturer proving the manufacturer's technical representative meets below specified requirements. Include name, address, telephone number, and experience record.

Submit documentation proving the installer is factory-trained, has the specified experience, and authorized by the manufacturer to install the products specified.

Coil stock compatibility; G

Provide certification of coil compatibility with roll forming machinery to be used for forming panels without warping, waviness, and rippling not part of panel profile; to be done without damage, abrasion or marking of finish coating.

SD-08 Manufacturer's Instructions

Installation manual; G

Submit manufacturers printed installation manual, instructions, and standard details.

SD-11 Closeout Submittals

Information card

For each roofing installation, submit a typewritten card or photoengraved aluminum card containing the information listed on Form 1 located at the end of this section.

1.5 DESIGN CALCULATIONS

Provide design calculations prepared by a professional engineer specializing in structural engineering verifying that system supplied and any additional framing meets design load criteria indicated. Coordinate calculations with manufacturer's test results. Include calculations for:

Wind load uplift design pressure at roof locations specified in paragraph entitled "Wind Uplift."

Clip spacing and allowable load per clip.

Fastening of clips to structure or intermediate supports.

Intermediate support spacing and framing and fastening to structure when required.

Allowable panel span at anchorage spacing indicated.

Safety factor used in design loading.

Governing code requirements or criteria.

Edge and termination details.

1.6 QUALITY ASSURANCE

1.6.1 Preroofing Conference

After submittals are received and approved but before roofing and insulation work, including associated work, is preformed, the Contractor shall hold a preroofing conference to review the following:

- a. The drawings and specifications
- b. Procedure for on site inspection and acceptance of the roofing substrate and pertinent structural details relating to the roofing system
- c. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing
- d. Safety requirements

The preroofing conference shall be attended by the Contractor and personnel directly responsible for the roofing and insulation installation, mechanical and electrical work, and the roofing manufacturer's technical representative. Conflicts among those attending the preroofing conference shall be resolved and confirmed in writing before roofing work, including associated work, is begun. Prepare written minutes of the preroofing conference and submit to the Contracting Officer.

1.6.2 Manufacturer

The SSMRS shall be the product of a metal roofing industry - recognized

manufacturer who has been in the practice of manufacturing SSMRS for a period of not less than 5 years and who has been involved in at least 5 projects similar in size and complexity to this project.

1.6.3 Manufacturer's Technical Representative

The representative shall have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and with installations in the geographical area where construction will take place. The manufacturer's representative shall be an employee of the manufacturer with at least 5 years experience in installing the roof system. The representative shall be available to perform field inspections and attend meetings as required herein, and as requested by the Contracting Officer.

1.6.4 Installer's Qualifications

The roofing system installer shall be factory-trained, approved by the metal roofing system manufacturer to install the system, and shall have a minimum of three years experience as an approved applicator with that manufacturer. The applicator shall have applied five installations of similar size and scope as this project within the previous 3 years.

1.6.5 Single Source

Roofing panels, clips, closures, and other accessories shall be standard products of the same manufacturer; shall be the latest design by the manufacturer; and shall have been designed by the manufacturer to operate as a complete system for the intended use.

1.6.6 Laboratory Tests For Panel Finish

The term "appearance of base metal" refers to the metal coating on steel. Panels shall meet the following test requirements:

- a. Formability Test: When subjected to a 180 degree bend over a 1/8 inch diameter mandrel in accordance with ASTM D 522, exterior coating film shall show only slight micro checking and no loss of adhesion.
- b. Accelerated Weathering Test: Withstand a weathering test for a minimum of 2000 hours in accordance with ASTM G 23, Method 1 without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with a penknife blade or similar instrument shall be considered to indicate loss of adhesion.
- c. Chalking Resistance: After the 2000-hour weatherometer test, exterior coating shall not chalk greater than No. 8 rating when measured in accordance with ASTM D 4214 test procedures.
- d. Color Change Test:

After the 2000 -hour weatherometer test, exterior coating color

change shall not exceed 2 NBS units when measured in accordance with ASTM D 2244 test procedure.

- e. Salt Spray Test: Withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of 10, no blisters in field as determined by ASTM D 714; and an average rating of 7, 1/16 inch failure at scribe, as determined by ASTM D 1654. Rating Schedule No. 1.
- f. Abrasion Resistance Test for Color Coating: When subjected to the falling sand test in accordance with ASTM D 968, coating system shall withstand a minimum of 50 liters of sand per mil thickness before appearance of base metal.
- g. Humidity Test: When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage, or corrosion.
- h. Gloss Test: The gloss of the finish shall be 30 plus or minus 5 at an angle of 60 degrees, when measured in accordance with ASTM D 523.
- i. Glare Resistance Test:

Surfaces of panels that will be exposed to the exterior shall have a specular reflectance of not more than 10 when measured in accordance with ASTM D 523 at an angle of 85 degrees. Specular reflectance may be obtained with striations or embossing. Requirements specified under "Formability Test" will be waived if necessary to conform to this requirement.

1.7 WARRANTY

Furnish manufacturer's no-dollar-limit materials and workmanship warranty for the roofing system. The warranty period shall be not less than 20 years from the date of Government acceptance of the work. The warranty shall be issued directly to the Government. The warranty shall provide that if within the warranty period the metal roofing system becomes non-watertight or shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the roofing system resulting from defective materials or installed workmanship the repair or replacement of the defective materials and correction of the defective workmanship shall be the responsibility of the roofing system manufacturer. Repairs that become necessary because of defective materials and workmanship while roofing is under warranty shall be performed within 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time will constitute grounds for having the repairs performed by others and the cost billed to the manufacturer. The Contractor shall also provide a 2 year contractor installation warranty.

1.8 DELIVERY, STORAGE AND HANDLING

Deliver, store, and handle preformed panels, bulk roofing products and other manufactured items in a manner to prevent damage or deformation.

1.8.1 Delivery

Provide adequate packaging to protect materials during shipment. Crated materials shall not be uncrated until ready for use, except for inspection. Immediately upon arrival of materials at the jobsite, inspect materials for damage, dampness, and staining. Damaged or permanently stained materials that cannot be restored to like-new condition shall be replaced with satisfactory material. If materials are wet, remove the moisture and re-stack and protect the panels until used.

1.8.2 Storage

Stack materials on platforms or pallets and cover with tarpaulins or other suitable weathertight covering which prevents water trapping or condensation. Store materials so that water which might have accumulated during transit or storage will drain off. Do not store the panels in contact with materials that might cause staining, such as mud, lime, cement, fresh concrete or chemicals. Protect stored panels from wind damage.

1.8.3 Handling

Handle material carefully to avoid damage to surfaces, edges and ends.

PART 2 PRODUCTS

2.1 ROOFING PANELS

Panels shall have interlocking ribs for securing adjacent sheets. System for securing the roof covering to structural framing members shall be concealed clip fastening system with no fasteners penetrating the panels except at the ridge or eave, rakes, penetrations, and end laps. Backing plates and ends of panels at end laps shall be predrilled or prepunched; factory prepare ends of panels to be lapped by trimming part of seam, die-setting or swaging ends of panels. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope when such slope is 30 feet or less. When length of run exceeds 30 feet, each sheet in the run shall extend over two or more spans. Sheets longer than 30 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide not less than 12 inches of coverage in place. Height of corrugations of adjacent roof sheets shall be not less than 1.75 inches (nominal). Make provisions for expansion and contraction at either ridge or eave, consistent with the type of system to be used. Panels from coil stock shall be formed without warping, waviness or ripples not part of the panel profile and shall be free of damage to the finish coating system.

2.1.1 Material

Zinc-coated steel conforming to ASTM A 653/A 653M, G90coating designation conforming to ASTM A 792/A 792M, AZ 55 coating. Minimum thickness to be

0.023 inch thick (24 gage) minimum except when mid field of roof is subject to design wind uplift pressures of 60 psf or greater, entire roof system shall have a minimum thickness of 0.030 inch (22 gage). Prior to shipment, treat mill finish panels with a passivating chemical and oil to inhibit the formation of oxide corrosion products. Dry, retreat, and re-oil panels that have become wet during shipment or storage but have not started to oxidize.

2.1.2 Texture

Smooth.

2.1.3 Finish

Factory color finish.

2.1.3.1 Factory Color Finish

Provide factory applied, thermally cured coating to exterior and interior of metal roof and wall panels and metal accessories. Provide exterior finish top coat of 70 percent resin polyvinylidene fluoride with not less than 0.8 mil dry film thickness. Provide exterior primer standard with panel manufacturer with not less than 0.8 mil dry film thickness. Interior finish shall consist of 0.2 mil dry film thickness prime coat dry film thickness backer coat. Provide exterior coating meeting test requirements specified below. Tests shall have been performed on same factory finish and thickness provided. Provide clear factory edge coating on all factory cut or unfinished edges.

2.2 INTERMEDIATE SUPPORTS

Fabricate panel subgirts, subpurlins, T-bars, Z-bars and tracks from galvanized steel conforming to ASTM A 653/A 653M, G90, Grade D (16 gage and heavier), Grade A (18 gage and lighter); or steel conforming to ASTM A 36/A 36M, ASTM A 570/A 570M , or ASTM A 607 prime painted with zinc-rich primer. Size, shape, thickness and capacity as required to meet the load and deflection criteria specified.

2.3 ATTACHMENT CLIPS

Fabricate clips from ASTM A 366/A 366M, ASTM A 570/A 570M, or ASTM A 607 steel hot-dip galvanized in accordance with ASTM A 653/A 653M, G 90, or Series 300 stainless steel. Size, shape, thickness and capacity as required to meet the load, insulation thickness and deflection criteria specified.

2.4 ACCESSORIES

Sheet metal flashings, trim, moldings, closure strips, caps, equipment curbs, and other similar sheet metal accessories used in conjunction with preformed metal panels shall be of the same material as used for the panels. Provide metal accessories with a factory color finish to match the roofing panels, except that such items which will be concealed after installation may be provided without the finish if they are stainless

steel. Metal shall be of a thickness not less than that used for the panels. Thermal spacer blocks and other thermal barriers at concealed clip fasteners shall be as recommended by the manufacturer except that wood spacer blocks are not allowed.

2.4.1 Closures

2.4.1.1 Rib Closures

Corrosion resisting steel, closed-cell or solid-cell synthetic rubber, neoprene or polyvinyl chloride pre-molded to match configuration of rib opening. Material for closures shall not absorb water.

2.4.1.2 Ridge Closures

Metal-clad foam or metal closure with foam secondary closure matching panel configuration for installation on surface of roof panel between panel ribs at ridge and head wall roof panel flashing conditions and terminations. Foam material shall not absorb water.

2.4.2 Fasteners

Zinc-coated steel, corrosion resisting steel, zinc cast head, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Design the fastening system to withstand the design loads specified. Exposed fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick.

2.4.2.1 Screws

Not smaller than No. 14 diameter if self-tapping type and not smaller than No. 12 diameter if self-drilling and self-tapping.

2.4.2.2 Bolts

Not smaller than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

2.4.2.3 Automatic End-Welded Studs

Automatic end-welded studs shall be shouldered type with a shank diameter of not smaller than 3/16 inch and cap or nut for holding covering against the shoulder.

2.4.2.4 Explosive Driven Fasteners

Fasteners for use with explosive actuated tools shall have a shank diameter of not smaller than 0.145 inch with a shank length of not smaller than 1/2 inch for fastening to steel and not smaller than one inch for fastening to concrete.

2.4.2.5 Rivets

Blind rivets shall be stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

2.4.3 Sealants

Elastomeric type containing no oil or asphalt. Exposed sealant shall cure to a rubberlike consistency. Concealed sealant shall be the non-hardening type. Seam sealant shall be factory-applied, non-skinning, non-drying, and shall conform to the roofing manufacturer's recommendations. Silicone-based sealants shall not be used in contact with finished metal panels and components unless approved otherwise by the Contracting Officer.

2.5 UNDERLAYMENT FOR WOOD SUBSTRATES

ASTM D 226, Type I perforated, covered by water-resistant rosin sized building paper.

PART 3 EXECUTION

3.1 EXAMINATION

Examine surfaces to receive standing seam metal roofing and flashing. Ensure that surfaces are plumb and true, clean, even, smooth, as dry and free from defects and projections which might affect the installation.

3.2 PROTECTION FROM CONTACT WITH DISSIMILAR MATERIALS

3.2.1 Cementitious Materials

Paint metal surfaces which will be in contact with mortar, concrete, or other masonry materials with one coat of alkali-resistant coating such as heavy-bodied bituminous paint.

3.2.2 Contact with Wood

Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3 INSTALLATION

Install in accordance with the approved manufacturer's erection instructions, shop drawings, and diagrams. Panels shall be in full and firm contact with attachment clips. Where prefinished panels are cut in the field, or where any of the factory applied coverings or coatings are abraded or damaged in handling or installation, they shall, after necessary repairs have been made with material of the same color as the weather coating, be approved before being installed. Seal completely openings through panels. Correct defects or errors in the materials. Replace materials which cannot be corrected in an approved manner with nondefective

materials. Provide molded closure strips where indicated and where necessary to provide weathertight construction. Use shims as required to ensure attachment clip line is true. Use a spacing gage at each row of panels to ensure that panel width is not stretched or shortened. Provide one layer of asphalt-saturated felt placed perpendicular to roof slope, covered by one layer of rosin-sized building paper placed parallel to roof slope with side laps down slope and attached with roofing nails. Overlap side and end laps 3 inches, offset seams in building paper with seams in felt.

3.3.1 Roof Panels

Apply roofing panels with the standing seams parallel to the slope of the roof. Provide roofing panels in longest practical lengths from ridge to eaves (top to eaves on shed roofs), with no transverse joints except at the junction of ventilators, curbs, skylights, chimneys, and similar openings. Install flashing to assure positive water drainage away from roof penetrations. Locate panel end laps such that fasteners do not engage supports or otherwise restrain the longitudinal thermal movement of panels.

Form field-formed seam type system seams in the field with an automatic mechanical seamer approved by the manufacturer. Attach panels to the structure with concealed clips incorporated into panel seams. Clip attachment shall allow roof to move independently of the structure, except at fixed points as indicated.

3.3.2 Flashings

Provide flashing, related closures and accessories as indicated and as necessary to provide a weathertight installation. Install flashing to ensure positive water drainage away from roof penetrations. Flash and seal the roof at the ridge, eaves and rakes, and projections through the roof. Place closure strips, flashing, and sealing material in an approved manner that will assure complete weather tightness. Details of installation which are not indicated shall be in accordance with the SMACNA ASMM, panel manufacturer's approved printed instructions and details, or the approved shop drawings. Allow for expansion and contraction of flashing.

3.3.3 Flashing Fasteners

Fastener spacings shall be in accordance with the panel manufacturer's recommendations and as necessary to withstand the design loads indicated. Install fasteners in roof valleys as recommended by the manufacturer of the panels. Install fasteners in straight lines within a tolerance of 1/2 inch in the length of a bay. Drive exposed penetrating type fasteners normal to the surface and to a uniform depth to seat gasketed washers properly and drive so as not to damage factory applied coating. Exercise extreme care in drilling pilot holes for fastenings to keep drills perpendicular and centered. Do not drill through sealant tape. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used in applying fasteners shall not exceed that recommended by the manufacturer. Remove panels deformed or otherwise damaged by over-torqued fastenings, and provide new panels.

3.3.4 Rib and Ridge Closure/Closure Strips

Set closure/closure strips in joint sealant material and apply sealant to mating surfaces prior to adding panel.

3.4 CLEANING

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, solder or weld marks and damage to the finish coating.

3.5 MANUFACTURER'S FIELD INSPECTION

Manufacturer's technical representative shall visit the site as necessary during the installation process to assure panels, flashings, and other components are being installed in a satisfactory manner. Manufacturer's technical representative shall perform a field inspection during the first 20 squares of roof panel installation and at substantial completion prior to issuance of warranty, as a minimum, and as otherwise requested by the Contracting Officer. Additional inspections shall not exceed one for 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer. Each inspection visit shall include a review of the entire installation to date. After each inspection, a report, signed by the manufacturer's technical representative, shall be submitted to the Contracting Officer noting the overall quality of work, deficiencies and any other concerns, and recommended corrective actions in detail. Notify Contracting Officer a minimum of 2 working days prior to site visit by manufacturer's technical representative.

3.6 COMPLETED WORK

Completed work shall be plumb and true without oil canning, dents, ripples, abrasion, rust, staining, or other damage detrimental to the performance or aesthetics of the completed roof assembly.

3.7 INFORMATION CARD

For each roof, provide a typewritten card, laminated in plastic and framed for interior display or a photoengraved 0.032 inchthick aluminum card for exterior display. Card to be 8 1/2 by 11 inches minimum and contain the information listed on Form 1 at end of this section. Install card near point of access to roof, or where indicated. Send a photostatic paper copy to EFACHESNAVFACENGCOM, Code 102, Building 212, Washington Navy Yard, Washington, DC 20374-2121.

3.8 FORM ONE

FORM 1 - PREFORMED STEEL STANDING SEAM ROOFING SYSTEM COMPONENTS

1. Contract Number:
2. Building Number & Location:
3. NAVFAC Specification Number:
4. Deck/Substrate Type:
5. Slopes of Deck/Roof Structure:
6. Insulation Type & Thickness:
7. Insulation Manufacturer:
8. Vapor Retarder: ()Yes ()No
9. Vapor Retarder Type:
10. Preformed Steel Standing Seam Roofing Description:
 - a. Manufacturer (Name, Address, & Phone No.):
 - b. Product Name:
 - c. Width:
 - d. Gage:
 - e. Base Metal:
 - f. Method of Attachment:
11. Repair of Color Coating:
 - a. Coating Manufacturer (Name, Address & Phone No.):
 - b. Product Name:
 - c. Surface Preparation:
 - d. Recoating Formula:
 - e. Application Method:
12. Statement of Compliance or Exception: _____

13. Date Roof Completed:
14. Warranty Period: From _____ To _____
15. Roofing Contractor (Name & Address):
16. Prime Contractor (Name & Address):
- Contractor's Signature _____ Date:
- Inspector's Signature _____ Date:

-- End of Section --

SECTION 07920

JOINT SEALANTS

09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 834 (1995) Latex Sealants

ASTM C 920 (1998) Elastomeric Joint Sealants

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Sealants

Primers

Bond breakers

Backstops

Data for the sealants shall include shelf life and recommended cleaning solvents.

1.3 ENVIRONMENTAL CONDITIONS

The ambient temperature shall be within the limits of 40 and 100 degrees F when sealant is applied.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, and material designation clearly marked thereon. Elastomeric sealant containers shall be labeled to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 100 F degrees or less than 0 degrees F.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2.1.1 Interior Sealant

ASTM C 834, Type S or M, Grade NS, Class 12.5, Use NT. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.	White
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	Medium bronze
c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	White
d. Joints between edge members for acoustical tile and adjoining vertical surfaces.	White
e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	White
f. Joints between shower receptors and ceramic tile..	White
g. Joints formed between tile floors and tile base cove.	White
h. Behind escutcheon plates at valve pipe penetrations and shower heads in showers.	White

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers,	Match adjacent surface color

LOCATION	COLOR
and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	
b. Masonry joints where shelf angles occur.	White
c. Expansion and control joints.	Match adjacent surface color
d. Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface color
e. Joints between ends of gravel stops, fascias, copings, and adjacent walls.	Match adjacent surface color

2.1.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	Gray
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	Gray

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer for the particular application.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces shall be clean, dry to the touch, and free from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. When resealing an existing joint, remove existing calk or sealant prior to applying new sealant.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multi component elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

<u>JOINT WIDTH</u>	<u>JOINT DEPTH</u>	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, stone, or _____:		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inches	1/2 inch	5/8 inch
Over 2 inches	(As recommended by sealant manufacturer)	

- b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding shall not be required on metal surfaces.

3.3.2 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

- a. Where indicated.
- b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios."

3.3.3 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.4 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.5 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Sealant shall be uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

- a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or

sanding.

- b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

SECTION 08110

STEEL DOORS AND FRAMES

09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A250.4 (1994) Test Procedure and Acceptance
Criteria for Physical Endurance for Steel
Doors and Hardware Reinforcings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 591/A 591M (1998) Steel Sheet, Electrolytic
Zinc-Coated, for Light Coating Mass
Applications

ASTM A 653/A 653M (1998) Steel Sheet, Zinc-Coated
(Galvanized) or Zinc-Iron Alloy-Coated
(Galvannealed) by the Hot-Dip Process

ASTM C 578 (1995) Rigid, Cellular Polystyrene Thermal
Insulation

ASTM C 591 (1994) Unfaced Preformed Rigid Cellular
Polyisocyanurate Thermal Insulation

ASTM C 665 (1998) Mineral-Fiber Blanket Thermal
Insulation for Light Frame Construction
and Manufactured Housing

ASTM D 2863 (1997) Measuring the Minimum Oxygen
Concentration to Support Candle-Like
Combustion of Plastics (Oxygen Index)

ASTM E 283 (1991) Rate of Air Leakage Through
Exterior Windows, Curtain Walls, and Doors
Under Specified Pressure Differences
Across the Specimen

DOOR AND HARDWARE INSTITUTE (DHI)

ANSI/DHI A115 (1991) Steel Door Preparation Standards
(Consisting of A115.1 through A115.6 and
A115.12 through A115.18)

HOLLOW METAL MANUFACTURER'S ASSOCIATION (HMMA)

HMMA HMM (1992) Hollow Metal Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1995) Fire Doors and Fire Windows

NFPA 105 (1993) Smoke-Control Door Assemblies

NFPA 252 (1995) Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDI)

ANSI/SDI 100 (1991) Standard Steel Doors and Frames

SDI 105 (1992) Recommended Erection Instructions
for Steel FramesSDI 107 (1984) Hardware on Steel Doors
(Reinforcement - Application)SDI 111B Recommended Standard Details for Dutch
DoorsSDI 111F Recommended Completed Opening Anchors for
Standard Steel Doors and FramesSDI 113 (1979) Apparent Thermal Performance for
Steel Door and Frame AssembliesSDI 114 (1979) Acoustical Performance for Steel
Door and Frame Assemblies

UNDERWRITERS LABORATORIES INC. (UL)

UL 10B (1997) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal
Procedures."

SD-02 Shop Drawings

Doors; G

Frames; G

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G

Schedule of frames; G

Submit door and frame locations.

SD-03 Product Data

Doors; G

Frames; G

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to ANSI/SDI 100 requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

ANSI/SDI 100, except as specified otherwise. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1 3/4 inches thick, unless otherwise indicated.

2.1.1 Door Grades

2.1.1.1 Heavy Duty Doors

ANSI/SDI 100, Grade II, Model 1, with core construction Type a for interior doors and Type b for exterior doors, of size(s) and design(s) indicated.

2.1.1.2 Extra Heavy Duty Doors

ANSI/SDI 100, Grade III, Model 1 with core construction Type a for interior doors and Type b for exterior doors, of size(s) and design(s) indicated.

2.2 CUSTOM HOLLOW METAL DOORS

Provide custom hollow metal doors where nonstandard steel doors are indicated. At the Contractor's option, custom hollow metal doors may be provided in lieu of standard steel doors. Door size(s), design, materials, construction, gages, and finish shall be as specified for standard steel doors and shall comply with the requirement of HMMA HMM. Fill all spaces in doors with insulation. Close top and bottom edges with steel channels not lighter than 16 gage. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Doors shall be 1 3/4 inches thick, unless otherwise indicated.

2.3 ACCESSORIES

2.3.1 Louvers

2.3.1.1 Interior Louvers

Louvers shall be stationary type where scheduled. Weld or tenon louver blades to frame and fasten assembly to door with moldings. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louvers of 20 gage steel.

2.3.1.2 Exterior Louvers

Louvers shall be inverted "Y" type with minimum of 55 percent net-free opening. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. Louvers shall have steel-framed insect screens secured to room side and readily removable. Provide aluminum wire cloth, 18 by 18 or 18 by 16 inch mesh, for insect screens. Net-free louver area to be before screening.

2.4 INSULATION CORES

Insulated cores shall be of type specified, shall provide maximum assembly U-value of .48 in accordance with SDI 113 and shall conform to:

- a. Rigid Polyurethane Foam: ASTM C 591, Type 1 or 2, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863; or
- b. Rigid Polystyrene Foam Board: ASTM C 578, Type I or II; or
- c. Mineral Fiber: ASTM C 665, Type I.

2.5 STANDARD STEEL FRAMES

ANSI/SDI 100, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners or knock-down field-assembled corners. Provide steel frames for doors, transoms, sidelights, mullions,

cased openings, and interior glazed panels, unless otherwise indicated.

2.5.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

2.5.2 Knock-Down Frames

Design corners for simple field assembly by concealed tenons, splice plates, or interlocking joints that produce square, rigid corners and a tight fit and maintain the alignment of adjoining members. Provide locknuts for bolted connections.

2.5.3 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and shall member with heads and jambs butt-welded thereto or knock-down for field assembly. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

2.5.4 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inches on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.5.5 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

2.5.5.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

- a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;

2.5.5.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

2.6 WEATHERSTRIPPING

As specified in Section 08710, "Door Hardware."

2.6.1 Integral Gasket

Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame, may be provided in lieu of head and jamb seals specified in Section 08710, "Door Hardware." Insert gasket in groove after frame is finish painted. Air leakage of weatherstripped doors shall not exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283.

2.7 HARDWARE PREPARATION

Reinforce, drill, and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI 107 and ANSI/DHI A115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of ANSI/SDI 100, as applicable. Punch door frames, with the exception of frames that will have weatherstripping gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.8 FINISHES

2.8.1 Factory-Primed Finish

Unless specified otherwise, phosphate treat and factory prime metal doors and frames as specified in ANSI/SDI 100, or paintable A25 galvanized steel without primer. Where coating is removed by welding, apply touchup of factory primer.

2.8.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior, interior and scheduled doors, frames and louvers from galvanized steel, ASTM A 653/A 653M, Coating Designation G90. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Phosphate treat and factory prime zinc-coated surfaces as specified in ANSI/SDI 100..

2.9 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

2.9.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction.

3.1.2 Doors

Hang doors in accordance with clearances specified in ANSI/SDI 100. After erection and glazing, clean and adjust hardware.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

-- End of Section --

SECTION 08120

ALUMINUM WINDOWFRAMES

09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

THE ALUMINUM ASSOCIATION, INCORPORATED (AA)

AA 45 (1980) Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 603.8 (1992; Addendum 1993) Pigmented Organic Coatings on Extruded Aluminum

AAMA 605.2 (1992; Addendum 1995) High Performance Organic Coatings on Architectural Extrusions and Panels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1997; Rev. A) Carbon Structural Steel

ASTM B 209M (1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 221M (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

ASTM B 221 (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM E 283 (1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM E 331 (1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Structural

Shapes and thicknesses of framing members shall be sufficient to withstand a design wind load of not less than 30 pounds per square foot of supported area with a deflection of not more than 1/175 times the length of the member and a safety factor of not less than 1.65. Provide glazing beads, moldings, and trim of not less than 0.050 inch nominal thickness.

1.2.2 Air Infiltration

When tested in accordance with ASTM E 283, air infiltration shall not exceed 0.06 cubic feet per minute per square foot of fixed area at a test pressure of 6.24 pounds per square foot (50 mile per hour wind).

1.2.3 Water Penetration

When tested in accordance with ASTM E 331, there shall be no water penetration at a pressure of 8 pounds per square foot of fixed area.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Window frames; G

Show elevations of each window type, and frames, metal gages, details frame construction, methods of anchorage, glazing details, and details of installation.

SD-08 Manufacturer's Instructions

Window frames

Submit detail specifications and instructions for installation, adjustments, cleaning, and maintenance.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on nonabsorptive strips or wood platforms. Do not cover frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which calking and glazing compounds must adhere.

PART 2 PRODUCTS

2.1 WINDOW FRAMES

Window frames of size, design, and location indicated. Provide complete window frames, framing members , trim, and accessories.

2.2 MATERIALS

2.2.1 Anchors

Stainless steel .

2.2.2 Aluminum Alloy Window Frames

ASTM B 221, Alloy 6063-T5 for extrusions. ASTM B 209, alloy and temper best suited for aluminum sheets and strips.

2.2.3 Fasteners

Hard aluminum or stainless steel.

2.3 FABRICATION

2.3.1 Aluminum Frames

Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 12 inches o.c. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

2.3.2 Welding and Fastening

Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and shall have countersunk heads. Weld concealed reinforcements for hardware in place.

2.3.3 Anchors

On the backs of subframes, provide anchors of the sizes and shapes indicated for securing subframes to adjacent construction. Anchor transom bars at ends and mullions at head and sill. Place anchors near top and bottom of each jamb and at intermediate points not more than 25 inches apart.

2.3.4 Provisions for Glazing

Provide extruded aluminum snap-in glazing beads on interior side of doors. Provide extruded aluminum, theft-proof, snap-in glazing beads or fixed glazing beads on exterior or security side of doors. Glazing beads shall have vinyl insert glazing gaskets. Design glazing beads to receive glass of thickness indicated or specified. Glazing is specified in Section 08800,

"Glazing."

2.3.5 Finishes

Provide exposed aluminum surfaces with factory finish of anodic coating or organic coating.

2.3.5.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA 45. Finish shall be clear (natural), designation AA-M10-C22-A31, Architectural Class II 0.4 mil to 0.7 mil.

PART 3 EXECUTION

3.1 INSTALLATION

Plumb, square, level, and align frames and framing members to receive windows. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions. Anchor bottom of each frame to sill construction with 3/32 inch thick stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Seal metal-to-metal joints between framing members as specified in Section 07920, "Joint Sealants."

3.2 PROTECTION FROM DISSIMILAR MATERIALS

3.2.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by one or a combination of the following methods:

- a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.
- b. Apply a good quality elastomeric sealant between the aluminum and the dissimilar metal.
- c. Paint the dissimilar metal with one coat of primer and one coat of aluminum paint.
- d. Use a nonabsorptive tape or gasket in permanently dry locations.

3.2.2 Drainage from Dissimilar Metals

In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint, to prevent aluminum discoloration.

3.2.3 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.2.4 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting the aluminum, the Contractor shall have the option of painting the wood or other absorptive surface with two coats of aluminum paint and sealing the joints with elastomeric sealant.

3.3 CLEANING

Upon completion of installation, clean frame surfaces in accordance with framing manufacturer's recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.

3.4 PROTECTION

Protect frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged frames to original condition, or replace with new ones.

-- End of Section --

SECTION 08710

DOOR HARDWARE
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283 (1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM F 883 (1990) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION, INC. (BHMA)

ANSI/BHMA A156.1 (1997) Butts and Hinges (BHMA 101)

ANSI/BHMA A156.2 (1996) Bored and Preassembled Locks and Latches (BHMA 601)

ANSI/BHMA A156.3 (1994) Exit Devices (BHMA 701)

ANSI/BHMA A156.4 (1992) Door Controls - Closers (BHMA 301)

ANSI/BHMA A156.5 (1992) Auxiliary Locks & Associated Products (BHMA 501)

ANSI/BHMA A156.6 (1994) Architectural Door Trim (BHMA 1001)

ANSI/BHMA A156.7 (1988) Template Hinge Dimensions

ANSI/BHMA A156.8 (1994) Door Controls - Overhead Holders (BHMA 311)

ANSI/BHMA A156.12 (1992) Interconnected Locks & Latches (BHMA 611)

ANSI/BHMA A156.13 (1994) Mortise Locks & Latches (BHMA 621)

ANSI/BHMA A156.15 (1995) Closer Holder Release Devices

ANSI/BHMA A156.16 (1997) Auxiliary Hardware

ANSI/BHMA A156.17 (1993) Self Closing Hinges & Pivots

ANSI/BHMA A156.18 (1993) Materials and Finishes (BHMA 1301)

ANSI/BHMA A156.21 (1996) Thresholds

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1999) Fire Doors and Fire Windows

NFPA 101 (1997) Life Safety Code

STEEL DOOR INSTITUTE (SDI)

ANSI/SDI 100 (1991) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES INC. (UL)

UL BMD (1999) Building Materials Directory

UL 14C (1999) Swinging Hardware for Standard
Tin-Clad Fire Doors Mounted Singly and in
Pairs

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Hardware schedule; G

Keying system

SD-03 Product Data

Hardware items; G

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1

Submit data package in accordance with Section 01781, "Operation and Maintenance Data."

SD-11 Closeout Submittals

Key bitting

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hard- ware Item	Quan- tity	Size	Reference Publi- cation Type No.	Finish	Mfr. Name and Catalog No.	Key Con- trol Symbols	UL Mark (If fire rated and listed)	ANSI/BHMA Finish Designa- tion
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1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

- a. Complete listing of all keys (AA1, AA2, etc.).
- b. Complete listing of all key cuts (AA1-123456, AA2-123458).
- c. Tabulation showing which key fits which door.
- d. Copy of floor plan showing doors and door numbers.
- e. Listing of 20 percent more key cuts than are presently required in each master system.

1.5 QUALITY ASSURANCE

1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware to be applied to metal or to prefinished doors shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to ANSI/BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements specified, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Such hardware shall bear the label

of Underwriters Laboratories, Inc., and be listed in UL BMD or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Hinges, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

ANSI/BHMA A156.1, 4 1/2 by 4 1/2 inches unless otherwise specified. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

2.3.2 Locks and Latches

2.3.2.1 Bored Locks and Latches

ANSI/BHMA A156.2, Series 4000, Grade 1.

2.3.2.2 Auxiliary Locks

ANSI/BHMA A156.5, Grade 1.

2.3.3 Exit Devices

ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Touch bars shall be provided in lieu of conventional crossbars and arms. Provide escutcheons, not less than 7 by 2 1/4 inches.

2.3.4 Exit Locks With Alarm

ANSI/BHMA A156.5, Type E0431 (with full-width horizontal actuating bar) for single doors; Type E0431 (with actuating bar) or E0471 (with actuating bar and top and bottom bolts, both leaves active) for pairs of doors, unless otherwise specified. Provide terminals for connection to remote indicating panel. Provide outside control key.

2.3.5 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Cylinders and cores shall have seven pin tumblers. Cylinders shall be products of one manufacturer, and cores shall be the products of one manufacturer. Rim cylinders, mortise cylinders, and knobs of bored locksets shall have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.3.6 Keying System

Provide a master keying system an extension of the of the existing keying system.

2.3.7 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.7.1 Lever Handles

Provide lever handles in lieu of knobs. Lever handles for exit devices shall meet the test requirements of ANSI/BHMA A156.13 for mortise locks. Lever handle locks shall have a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when a force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Lever handles shall return to within 1/2 inch of the door face.

2.3.7.2 Texture

Provide knurled or abrasive coated knobs or lever handles.

2.3.8 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish 10 construction master keys, and 10 control keys for removable cores. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.3.9 Door Bolts

ANSI/BHMA A156.16. Provide dust proof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: ANSI/BHMA A156.3, Type 25.

2.3.10 Closers

ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.10.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.3.11 Overhead Holders

ANSI/BHMA A156.8.

2.3.12 Door Protection Plates

ANSI/BHMA A156.6.

2.3.12.1 Sizes of Kick Plates

Width for single doors shall be 2 inches less than door width; width for pairs of doors shall be one inch less than door width. Height of kick plates shall be 8 inches for flush doors and one inch less than height of bottom rail for panel doors.

2.3.13 Door Stops and Silencers

ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.14 Padlocks

ASTM F 883.

2.3.15 Thresholds

ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.16 Weather Stripping

A set shall include head and jamb seals and sweep strips,. Air leakage of weather stripped doors shall not exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283. Weather stripping shall be one of the following:

2.3.17 Soundproofing

A set shall include adjustable doorstops at head and jambs and an automatic door bottom, both of extruded aluminum, clear (natural) anodized, surface applied, with vinyl fin seals between plunger and housing. Doorstops shall have solid neoprene tube, silicone rubber, or closed-cell sponge gasket. Door bottoms shall have adjustable operating rod and silicone rubber or closed-cell sponge neoprene gasket. Doorstops shall be mitered at corners. Zero "Sound Stop 1" (No. 770 and No. 361); Pemko No. 350ASN and No. 430AS; National Guard No. 1038N and No. 420; or equal.

2.3.18 Rain Drips

Extruded aluminum, not less than 0.08 inch thick, clear anodized. Set drips in sealant conforming to Section 07920, "Joint Sealants," and fasten with stainless steel screws.

2.3.18.1 Overhead Rain Drips

Approximately 1 1/2 inches high by 2 1/2 inches projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.3.19 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

ANSI/BHMA A156.18. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface door closers which shall have aluminum paint finish, and except steel hinges which shall have BHMA 652 finish (satin chromium plated). Hinges for exterior doors shall be stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Exit devices may be provided in BHMA 626 finish in lieu of BHMA 630 finish. Exposed parts of concealed closers shall have finish to match lock and door trim. Hardware for aluminum doors shall be finished to match the doors.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping so as to prevent damage. Provide full contact, weather-tight seals. Doors shall operate without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inches o.c. after doors and frames have been finish painted.

3.1.1.2 Interlocking Type Weather Stripping

Provide interlocking, self-adjusting type on heads and jambs and flexible hook type at sills. Nail weather stripping to door one inch o.c. and to heads and jambs at 4 inches o.c.

3.1.2 Soundproofing Installation

Install as specified for stop-applied weather stripping.

3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws.

3.2 EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors.

3.3 HARDWARE LOCATIONS

ANSI/SDI 100, unless indicated or specified otherwise.

- a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

3.4 CONTROL SYSTEM

Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.6 HARDWARE SETS

LIST OF HARDWARE SETS

HW-1 (Doors 1, 4, 7, 8)

1 1/2 Pair Hinges	A2112 x 626 x NRP
1 Lockset	F04 x 630
1 Closer	C02021
1 Kick Plate	J102 x 630
1 Wall Bumper	L02251
1 Threshold	Type 26 x insert
1 Set Weatherstripping	As specified

HW-2 (Doors 3, 5, 6)

1 1/2 Pair Hinges	A8112 x 652
1 Lockset	F82
1 Closer	C02011
1 Kick Plate	J102 x 630
1 Wall Bumper	L02251

-- End of Section --

SECTION 08800

GLAZING
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; R 1994) Safety Glazing Materials
Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 669 (1995) Glazing Compounds for Back Bedding
and Face Glazing of Metal Sash

ASTM C 864 (1998) Dense Elastomeric Compression Seal
Gaskets, Setting Blocks, and Spacers

ASTM C 920 (1998) Elastomeric Joint Sealants

ASTM C 1036 (1991; R 1997) Flat Glass

ASTM C 1048 (1997; Rev. B) Heat-Treated Flat Glass -
Kind HS, Kind FT Coated and Uncoated Glass

ASTM D 673 (1993; Rev. A) Mar Resistance of Plastics

ASTM D 4802 (1994) Poly(Methyl Methacrylate) Acrylic
Plastic Sheet

ASTM E 163 (1984) Fire Tests of Window Assemblies

ASTM E 774 (1997) Sealed Insulating Glass Units

CODE OF FEDERAL REGULATIONS (CFR)

16 CFR 1201 Architectural Glazing Materials

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA GM (1997) Glazing Manual

GANA SM (1990) Sealant Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1995) Fire Doors and Fire Windows

SEALED INSULATING GLASS MANUFACTURERS ASSOCIATION (SIGMA)

SIGMA A1202 (1983) Commercial Insulating Glass
Dimensional Tolerances

SIGMA TM-3000 (1997) Glazing Guidelines for Sealed
Insulating Glass Units

SIGMA TB-3001 (1990) Sloped Glazing

UNDERWRITERS LABORATORIES INC. (UL)

UL ABPMED (1996) Automotive Burglary Protection and
Mechanical Equipment Directory

UL 752 (1995; R 1998) Bullet-Resisting Equipment

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-08 Manufacturer's Instructions

Setting and sealing materials

Glass setting

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.4 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.5 WARRANTY

1.5.1 Warranty for Insulating Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 5-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government.

PART 2 PRODUCTS

2.1 GLASS

ASTM C 1036, unless specified otherwise. In doors, provide safety glazing material conforming to 16 CFR 1201.

2.1.1 Clear Glass

Type I, Class 1 (clear), Quality q4 (A) . Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 1/8 inch float glass for openings up to and including 15 square feet, 3/16 inch for glazing openings over 15 square feet but not over 30 square feet, and 1/4 inch for glazing openings over 30 square feet but not over 45 square feet.

2.1.2 Wire Glass

Type II, Class 1, Form 1, Quality q8 Mesh , Pattern diamond, .23 inch thick.

2.1.3 Tempered Glass

ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (transparent) .

2.2 INSULATING GLASS UNITS

Two panes of glass separated by a dehydrated airspace and hermetically sealed. Dimensional tolerances shall be as specified in SIGMA A1202. The units shall conform to ASTM E 774, Class A.

2.2.1 Buildings

Provide 1/2 inch airspace. The inner light shall be ASTM C 1036, Type I, Class 1, Quality q4, 1/4 inch thick . The outer light shall be ASTM C 1036, Type I, Class 1 (transparent) , Quality q4, 1/4 inch thick .

2.2.2 Low Emissivity Glass

Insulating glass units (IGU) shall have a thin metallic high-transmittance coating applied to the number 2 surface of the unit. The U-value for the IGU shall be no greater than 0.34.

2.3 SETTING AND SEALING MATERIALS

Provide as specified in the GANA GM, SIGMA TM-3000, SIGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, non resilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

2.3.1 Glazing Compound

ASTM C 669. Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

2.3.2 Elastomeric Sealant

ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G. Use for channel or stop glazing metal sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes, with sealants used in manufacture of insulating glass units .

2.3.3 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition.

2.3.4 Sealing Tapes

Preformed, semisolid, polymeric-based material of proper size and compressibility for the particular condition. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.

2.3.5 Setting Blocks and Edge Blocks

Lead or neoprene of 70 to 90 Shore "A" durometer hardness, chemically compatible with sealants used, and of sizes recommended by the glass manufacturer.

2.3.6 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA GM, GANA SM, SIGMA TB-3001, SIGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is

approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA GM, GANA SM, SIGMA TB-3001, SIGMA TM-3000, and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of SIGMA TB-3001 and SIGMA TM-3000.

-- End of Section --

SECTION 09250

GYPSUM BOARD
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|--------------|--|
| ANSI A108.11 | (1992) Interior Installation of
Cementitious Backer Units |
| ANSI A118.9 | (1992) Cementitious Backer Units |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------------|--|
| ASTM C 36 | (1997) Gypsum Wallboard |
| ASTM C 442 | (1997) Gypsum Backing Board and Coreboard |
| ASTM C 475 | (1994) Joint Compound and Joint Tape for
Finishing Gypsum Board |
| ASTM C 514 | (1996) Nails for the Application of Gypsum
Board |
| ASTM C 630/C 630M | (1996; Rev. A) Water-Resistant Gypsum
Backing Board |
| ASTM C 557 | (1993; Rev. A) Adhesives for Fastening
Gypsum Wallboard to Wood Framing |
| ASTM C 840 | (1998) Application and Finishing of Gypsum
Board |
| ASTM C 954 | (1998) Steel Drill Screws for the
Application of Gypsum Board or Metal
Plaster Bases to Steel Studs from 0.033
in. (0.84 mm) to 0.112 in. (2.84 mm) in
Thickness |
| ASTM C 960/C 960M | (1997) Predecorated Gypsum Board |
| ASTM C 1002 | (1998; Rev. A) Steel Drill Screws for the
Application of Gypsum Panel Products or
Metal Plaster Bases |

ASTM C 1047	(1998) Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1178/C 1178M	(1996) Glass Mat Water-Resistant Gypsum Backing Board
ASTM E 84	(1998) Surface Burning Characteristics of Building Materials

GYPSUM ASSOCIATION (GA)

GA 216	(1996) Application and Finishing of Gypsum Board
GA 224	(1997) Installation of Predecorated Gypsum Board
GA 600	(1997) Fire Resistance and Sound Control Design Manual

UNDERWRITERS LABORATORIES INC. (UL)

UL FRD	(1997) Fire Resistance Directory
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1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Accessories

Submit for each type of gypsum board and for cementitious backer units.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified herein. Provide gypsum board manufactured from asbestos-free materials.

2.1.1 Gypsum Board

ASTM C 36.

2.1.1.1 Regular

48 inches wide, 1/2 inch thick, tapered edges.

2.1.1.2 Foil-Backed

48 inches wide, 1/2 inch thick, tapered edges.

2.1.1.3 Type X (Special Fire-Resistant)

48 inches wide, 1/2 inch thick, tapered edges.

2.1.2 Gypsum Backing Board

ASTM C 442.

2.1.2.1 Regular

48 inches wide, 1/2 inch thick, square edges.

2.1.3 Joint Treatment Materials

ASTM C 475.

2.1.3.1 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.3.2 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.3.3 Joint Tape

Cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.4 Fasteners

2.1.4.1 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick.

2.1.5 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.6 Water

Clean, fresh, and potable.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified herein. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length. Cut out gypsum board as

required to make neat close joints around openings. Surfaces of gypsum board and substrate members may be bonded together with an adhesive, except where prohibited by fire rating(s). Treat edges of cutouts for plumbing pipes, screw heads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Single-Ply Gypsum Board to Wood Framing

Apply in accordance with ASTM C 840, System I or GA 216.

3.2.2 Floating Interior Angles

Locate the attachment fasteners adjacent to ceiling and wall intersections in accordance with ASTM C 840, System XII or GA 216, for single-ply and two-ply applications of gypsum board to wood framing.

3.2.3 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C 840, System XIII or GA 216, unless indicated otherwise.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS AND GLASS MAT WATER-RESISTANT GYPSUM BACKING BOARD

3.3.1 Joint Treatment

ANSI A108.11.

3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840 or GA 216. Provide joint, fastener depression, and corner treatment. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer.

3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07920, "Joint Sealants." Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.6 PATCHING

Patch surface defects in gypsum.

-- End of Section --

SECTION 09310

CERAMIC TILE, QUARRY TILE, AND PAVER TILE
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1	(1992) Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar
ANSI A108.4	(1992) Ceramic Tile Installed with Organic Adhesives or Water-Cleanable Tile Setting Epoxy Adhesive (Available only as part of ANSI A108.1)
ANSI A108.5	(1992) Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar (Available only as part of ANSI A108.1)
ANSI A108.6	(1992) Ceramic Tile Installed with Chemical-Resistant, Water-Cleanable Tile Setting and Grouting Epoxy (Available only as part of ANSI A108.1)
ANSI A108.8	(1992) Ceramic Tile Installed with Chemical-Resistant, Water-Cleanable Tile Setting and Grouting Epoxy (Available only as part of ANSI A108.1)
ANSI A108.10	(1992) Installation of Grout in Tilework (Available only as part of ANSI A108.1)
ANSI A118.1	(1992) Dry-Set Portland Cement Mortar (Available only as part of ANSI A108.1)
ANSI A118.3	(1992) Chemical-Resistant, Water-Cleanable Tile-Setting and Grouting Epoxy and Water-Cleanable Tile-Setting Epoxy Adhesive (Available only as part of ANSI A108.1)
ANSI A118.4	(1992) Latex-Portland Cement Mortar (Available only as part of ANSI A108.1)

ANSI A118.5	(1992) Chemical-Resistant Furan Mortar and Grout (Available only as part of ANSI A108.1)
ANSI A136.1	(1992) Organic Adhesives for Installation of Ceramic Tile (Available only as part of ANSI A108.1)
ANSI A137.1	(1988) Ceramic Tile

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 497	(1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM C 144	(1997) Aggregate for Masonry Mortar
ASTM C 150	(1997; Rev. A) Portland Cement
ASTM C 206	(1984; R 1997) Finishing Hydrated Lime
ASTM C 207	(1991; R 1997) Hydrated Lime for Masonry Purposes
ASTM C 395	(1995) Chemical-Resistant Resin Mortars
ASTM C 658	(1993) Chemical-Resistant Resin Grouts for Brick or Tile
ASTM F 446	(1985; R 1993) Grab Bars and Accessories Installed in the Bathing Area

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-04 Samples

Ceramic floor tile; G

2 inch square sheets mounted showing colors, finish, pattern, and form of each type, with joints between the tiles grouted.

Ceramic wall tile; G

Sets of four tiles showing size, form, finish, and range and shades in each color, with joints between the tiles grouted.

Ceramic tile trim units; G

Pieces of each unit, showing color, finish, and type.

Ceramic tile accessories; G

Pieces of each type, showing color, finish, type, and style.

1.3 DELIVERY, STORAGE, AND HANDLING

ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6, Section A-1.

1.4 ENVIRONMENTAL CONDITIONS

ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6 Section A-1 as modified herein. Do not start tile work unless the ambient temperature in work area is at least 50 degrees F and rising. Maintain the ambient temperature above 50 degrees F while work is in progress and for at least 3 days after its completion. For the installation and subsequent cure of chemical-resistant epoxy and furan mortars, the temperature shall be at least 60 degrees F and rising for a period of time recommended by the manufacturer. Do not use adhesives in unventilated areas.

1.5 EXTRA STOCK

Supply an extra two percent of each type tile used in clean and marked cartons.

PART 2 PRODUCTS

2.1 MATERIALS

ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6 Section A-2.

2.1.1 Tile

ANSI A137.1, Standard Grade.

2.1.1.1 Color and Patterns

Tile colors and patterns shall be as indicated. Colors and patterns indicated by reference to manufacturer's name and designations are for color and pattern identification only and are not intended to limit selection of other manufacturer's products with similar colors and patterns.

2.1.1.2 Ceramic Floor Tile

- a. Unglazed ceramic mosaic tile: ANSI A137.1, porcelain or natural clay with cushioned edges.

Nominal Facial Dimensions
in inches:

Nominal Thickness
in inches:

2 by 2

1/4

Slip resistant: The body of the tile shall have a content of 7.5

plus or minus percent by weight of abrasive grains. Provide in the following areas: shower rooms and stalls .

2.1.1.3 Wall Tile

- a. Glazed wall tile: ANSI A137.1, bright finish with cushioned edges.

Nominal Facial Dimensions
in inches:

4 1/4 by 4 1/4

Nominal Thickness
in inches:

5/16

2.1.1.4 Trim Units

Provide matching trim units and accessories with tile work. Provide where indicated for a complete and finished installation. Identification numbers for trim unit shapes are cited in ANSI A137.1. Provide 4 inch coved base units for tile floors where wainscots are not provided. Internal corners shall be squared and external corners rounded using appropriate matching trim units.

2.1.1.5 Accessories

Built-in ceramic type, same materials and finish as glazed wall tile. Locations for accessories which are specified but not indicated, shall be as directed by the Contracting Officer. Provide the following accessories:

	Quantity	Location
a. Recessed soap holders	2	Rooms 3 & 4
b. Towel bars, stainless steel 24 inches long, two towel posts	1	Room 4
c. Robe hooks	2	Room 4

2.1.2 Hydrated Lime

ASTM C 206, Type S; or ASTM C 207, Type S.

2.1.3 Aggregate

ASTM C 144, except sand for grout shall pass a number 16 sieve.

2.1.4 Water

Clean, potable.

2.1.5 Portland Cement

ASTM C 150, Type 1, white for grout, gray for other uses.

2.1.6 Membrane or Cleavage Membrane

ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6, Section A-2.

2.1.7 Thresholds

Hard, sound, domestic marble , minimum one inch thick for mud bed application and 1/2 inch thick for thin-set application, unless indicated otherwise. Round edges exposed to foot traffic. Sand-rubbed finish on exposed surfaces. Bevel vertical edges to maximum of 1/2 inch in height or as indicated. Color to be gray.

2.1.8 Mortars and Grouts

2.1.8.1 Mortar and Adhesives, Tile Setting

- a. Portland cement mortar: ANSI A108.1 Section A4.1 for proportions .
- b. Latex-portland cement mortar: ANSI A118.4.

2.1.8.2 Grout

- a. Commercial portland cement: ASTM C 150; ANSI A108.1, Section A4.1 for proportions.
- b. Sand portland cement: ASTM C 150; ANSI A108.1, Section A4.1 for proportions.
- c. Latex-portland cement: ANSI A118.4.

2.1.9 Sealants and Calkings

Provide sealants and calkings in joints between tile as specified in Section 07920, "Joint Sealants."

PART 3 EXECUTION

3.1 EXAMINATION

Do not start tile work until roughing in for plumbing, heating, ventilating, air conditioning, and electrical work has been installed and tested; and built-in bathtubs, shower stalls, and membrane waterproofing have been installed and tested.

3.2 PREPARATION

3.2.1 Concrete Subfloor Preparation

Do not begin floor tile installation in areas receiving wall tile until wall tile installation has been completed.

3.2.1.1 Slab on Grade Construction Where No Bending Stresses Occur

Prepare in accordance with ANSI A108.1 and ANSI A108.5 .

3.2.2 Preparation of Mortar Mixes

Measure mortar materials in approved containers to ensure that proportions of materials will be controlled and accurately maintained. Measuring materials with shovels is not permitted. Unless specified otherwise, mix mortar in proportions by volume in approved mixing machines or mortar boxes. Control the quantity of water accurately and uniformly.

3.3 INSTALLATION

3.3.1 Floor Tile

- a. Portland cement mortar: ANSI A108.1 ceramic mosaic, tile. Recess, or depress setting bed where indicated.
- b. Chemical-resistant, water-cleanable, tile-setting and grouting epoxy: ANSI A108.6.
- c. Dry-set mortar: ANSI A108.5.
- d. Latex-portland cement mortar: ANSI A108.5.
- e. Furan: ANSI A108.8, ANSI A118.5.

3.3.2 Joints

Make parallel, plumb, level, and in alignment. Make end joints in broken-joint work on center lines of adjoining tiles, as far as practicable. Set square tiles with straight joints.

3.3.2.1 Joint Width

Make joints uniform in width and space to accommodate tile with a minimum of cutting, but maintain standard mounting widths between units abutting sheets of mounted ceramic mosaic tile. Make joint widths as follows:

- a. Mounted tile: As determined by the mounted tile spacing.
- b. Unmounted Glazed Wall Tile: As determined by spacing lugs.
- c. Quarry tile: 1/4 inch minimum, width of 3/8 inch maximum.
- d. Trim units and accessories: Match adjoining tile units.

3.3.2.2 Grouting and Pointing Joints

Color shall be as indicated.

- a. Grout tile in accordance with ANSI A108.10.

3.3.2.3 Expansion and Control Joints

Provide expansion and control joints in tile work in accordance with ANSI A108.1, ANSI A108.4, ANSI A108.5 and ANSI A108.6 and where indicated.

Install expansion and control joints as follows:

- a. Insert preformed joint filler or back-up material in joints to proper depth to provide correct cavity depth for sealant.
- b. Prior to grouting, keep joints open and clean by stuffing with paper or other material to prevent filling with dirt, grout, or mortar.
- c. After tile is grouted and completely dry, remove paper or other temporary filler material; brush joints clean and fill with back-up material and sealant as specified in Section 07920, "Joint Sealants."

3.3.3 Thresholds

Align edges with faces of trim on both sides of openings. Fit thresholds neatly and bed properly in cement mortar flush with adjoining floors.

3.3.4 Curing

Cover floors with 30 pound natural kraft paper with joints overlapping at least 4 inches and tape-sealed or held down with planks or other weights. Allow to damp cure for at least 72 hours before permitting foot traffic on tiled floor. Cure in accordance with ANSI A108.6.

3.4 CLEANING

Clean in accordance with ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6, Section A-3. Acid cleaning of unglazed tile when necessary, shall be done no sooner than 14 days after setting tile.

3.5 PROTECTION

Meet the requirements of ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6 Section A-3. Cover finished tile floors with clean, 30 pound natural kraft paper before permitting foot traffic. Place board walkways on floors that are to be continuously used as passageways by workers. Cover marble stools and thresholds with boards. Protect tiled corners, external angles, with board corner strips in areas used as passageways by workers.

-- End of Section --

SECTION 09900

PAINTS AND COATINGS
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH TLV-BKLT	(1991-1992) Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
ACGIH TLV-DOC	Documentation of Threshold Limit Values and Biological Exposure Indices

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 669	(1995) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM D 2092	(1995) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
ASTM D 2824	(1994) Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, Asbestos Fibered, and Fibered Without Asbestos
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4263	(1983; R 1999) Indicating Moisture in Concrete by the Plastic Sheet Method

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.1001	Asbestos, Tremolite, Anthophyllite, and Actinolite
29 CFR 1910.1025	Lead
29 CFR 1926.62	Lead Exposure in Construction

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-341	(Rev. A) Pigment, Aluminum, Powder and Paste
CID A-A-378	Putty, Linseed Oil Type (For Wood Sash Glazing)
CID A-A-1500	(Rev. A) Sealer, Surface (Latex Block Filler)
CID A-A-1558	(Rev. A) Paint, Stencil
CID A-A-1800	Varnish, Oil: Spar
CID A-A-2246	Paint, Latex (Gloss, Interior)
CID A-A-2335	Sealer, Surface (Varnish Type, Wood and Cork Floors)
CID A-A-2336	(Rev. A) Primer Coating (Alkyd, Exterior Wood, White and Tints)
CID A-A-2904	Thinner, Paint, Mineral Spirits, Regular and Odorless
CID A-A-2962	Enamel, Alkyd, Class A, Grade C
CID A-A-2994	Primer Coating, Interior, for Walls and Wood
CID A-A-3054	Paint, Heat Resisting (400 Degrees F)
CID A-A-3067	Paint, Alkyd, Exterior, Low VOC
CID A-A-3120	Paint: For Swimming Pools
CID A-A-50557	Primer, Water-Borne, Acrylic or Modified Acrylic, For Metal Surfaces
CID A-A-50570	Paint Water-Borne, Acrylic or Modified Acrylic, Semigloss, for Metal Surfaces
CID A-A-50574	Enamel, Odorless, Alkyd, Interior, Semigloss, White and Tints

FEDERAL STANDARDS (FED-STD)

FED-STD-313	(Rev. C) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
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FEDERAL SPECIFICATIONS (FS)

FS TT-P-19	(Rev. D; Am. 1) Paint, Latex (Acrylic Emulsion, Exterior Wood and Masonry)
FS TT-P-28	(Rev. G) Paint, Aluminum, Heat Resisting (1200 DEG. F)
FS TT-P-29	(Rev. K) Paint, Latex Base
FS TT-P-38	(Rev. E) Paint, Aluminum (Ready-Mixed)
FS TT-E-487	(Rev. E; Am. 1) Enamel: Floor and Deck
FS TT-E-489	(Rev. J) Enamel, Alkyd, Gloss, Low VOC Content
FS TT-E-506	(Rev. K) Enamel, Alkyd, Gloss, Tints and White
FS TT-C-542	(Rev. E) Coating, Polyurethane, Oil-Free, Moisture Curing
FS TT-C-555	(Rev. B; Am. 1) Coating, Textured (for Interior and Exterior Masonry Surfaces)
FS TT-P-641	(Rev. G; Am. 1) Primer Coating, Zinc Dust-Zinc Oxide (For Galvanized Surfaces)
FS TT-P-645	(Rev. B) Primer, Paint, Zinc-Molybdate, Alkyd Type
FS TT-P-650	(Rev. D) Primer Coating, Latex Base, Interior, White (for Gypsum Wallboard or Plaster)
FS TT-P-664	(Rev. D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant
FS TT-S-708	(Rev. A; Am. 2) Stain, Oil: Semi-Transparent, Wood, Exterior
FS TT-S-711	(Rev. C) Stain; Oil Type, Wood, Interior
FS TT-E-1593	(Rev. B) Enamel, Silicone Alkyd Copolymer, Gloss (For Exterior and Interior Use)
FS TT-E-2784	(Rev. A) Enamel (Acrylic Emulsion, Exterior)

MILITARY SPECIFICATIONS (MIL)

MIL-P-24441	(Rev. B; Supp. 1) Paint, Epoxy-Polyamide
MIL-C-24667	(Rev. A) Coating System, Nonskid, for Roll or Spray Application (Metric)
MIL-PRF-85285	(Rev. C) Coatings: Polyurethane, High-Solids

MILITARY STANDARDS (MIL-STD)

MIL-STD-101	(Rev. B) Color Code for Pipelines and for Compressed Gas Cylinders
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STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Guide 6	(1995) Containing Debris Generated During Paint Removal Operations
SSPC Guide 7	(1995) Disposal of Lead-Contaminated Surface Preparation Debris
SSPC QP 1	(1989) Evaluating Qualifications of Painting Contractors (Field Application to Complex Structures)
SSPC PA 1	(1991) Shop, Field, and Maintenance Painting
SSPC PA 3	(1995) Safety in Paint Application
SSPC VIS 3	(1995) Visual Standard for Power-and Hand-Tool Cleaned Steel (Standard Reference Photographs)
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 5	(1994) White Metal Blast Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning
SSPC SP 10	(1994) Near-White Blast Cleaning
SSPC SP 12	(1995) Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultrahigh-Pressure Water Jetting Prior to Recoating
SSPC Paint 20	(1991) Zinc-Rich Primers (Type I,

"Inorganic," and Type II, "Organic")

SSPC Paint 21 (1991) White or Colored Silicone Alkyd
Paint Type I, High Gloss Type II, Medium
Gloss

SSPC Paint 22 (1991) Epoxy-Polyamide Paints (Primer,
Intermediate, and Topcoat)

SSPC Paint 23 (1991) Latex Primer for Steel Surfaces

SSPC Paint 24 (1991) Latex Semi-Gloss Exterior Topcoat

SSPC Paint 104 (1991) White or Tinted Alkyd Paint

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal
Procedures."

SD-02 Shop Drawings

Piping identification

Submit color stencil codes.

SD-03 Product Data

Coating; G

For each type of coating, sealant, or other product furnished,
submit data from the manufacturer's paint laboratory indicating
that the product conforms to requirements of the referenced
specification.

SD-04 Samples

Color; G

Submit manufacturer's samples of paint colors. Cross reference
color samples to color scheme as indicated.

SD-08 Manufacturer's Instructions

Manufacturer's material safety data sheets

Submit Manufacturer's material safety data sheets for coatings,
solvents, and other potentially hazardous materials, as defined in
FED-STD-313.

SD-07 Certificates

Applicator's qualifications

Evidence of acceptable variation; G

1.3 APPLICATOR'S QUALIFICATIONS

- a. Submit evidence that applicator has met certification requirements of SSPC Painting Contractor Certification Program as described in SSPC QP 1
- b. Submit evidence that applicator has satisfactorily applied paint by airless spray at minimum of two sites. Indicate names and locations of sites, and type and design of equipment used, including safety devices.

1.4 EVIDENCE OF ACCEPTABLE VARIATION

If a product proposed for use does not conform to requirements of the referenced specification, submit for approval to the Contracting Officer, evidence from the paint manufacturer's laboratory that the proposed product is either equal to or better than the product specified. The submittal shall include the following:

- a. Identification of the proposed substitute;
- b. Reason why the substitution is necessary;
- c. A comparative analysis of the specified product and the proposed substitute, including tabulations of the composition of pigment and vehicle;
- d. The differences between the specified product and the proposed substitute; and
- e. Other information necessary for an accurate comparison of the proposed substitute and the specified product.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications of Airless Spray Applicators

Satisfactory application of paint by airless spray at a minimum of two sites.

1.5.2 Field Samples and Tests

The Government will take one pint samples of paint at random from the products delivered to the job site and test them to verify that the products either conform to the referenced specifications or the approved substitution. Products which do not conform shall be removed from the job site and replaced with new products that conform to the referenced specification or the approved substitution.

1.6 REGULATORY REQUIREMENTS

1.6.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform to Air Quality Management District Rules (cited in Appendix A) for the location of the project. In localities where specified coating or paint is prohibited, the Contracting Officer may direct substitution of acceptable coating system.

1.6.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.6.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.6.4 Asbestos Content

Materials shall not contain asbestos.

1.6.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.6.6 Silica Sand

The use of silica sand is prohibited.

1.6.7 Human Carcinogens

Materials shall not contain ACGIH TLV-BKLT and ACGIH TLV-DOC confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.7 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.8 SAFETY METHODS

Apply coating materials using safety methods and equipment in accordance with the following:

1.8.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA 3.

1.8.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

- a. The chemical manufacturer when using mineral spirits, or other chemicals. Use impermeable gloves, chemical goggles or face shield, and other recommended protective clothing and equipment to avoid exposure of skin, eyes, and respiratory system. Conduct work in a manner to minimize exposure of building occupants and the general public.
- b. 29 CFR 1910.1000.
- c. ACGIH TLV-BKLT, threshold limit values.
- d. Manufacturer's material safety data sheets (MSDS).

1.9 ENVIRONMENTAL CONDITIONS

1.9.1 Exterior Coatings

Do not apply coating to surfaces during foggy or rainy weather, or under the following surface temperature conditions:

- a. Less than 5 degrees F above dew point;
- b. Below 40 degrees F (for oil-based paints), 50 degrees F (for latex paints or over 95 degrees F, unless approved by the Contracting Officer.

1.9.2 Interior Coatings

Apply coatings when surfaces to be painted are dry and the following surface temperatures can be maintained:

- a. Between 40 and 95 degrees F during application of enamels and varnishes;
- b. Between 50 and 95 degrees F during application of other coatings.

1.10 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

1.11 LOCATION AND SURFACE TYPE TO BE PAINTED

1.11.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

- a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
- b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.
- c. Existing coated surfaces that are damaged during performance of the work.

1.11.2 Painting Excluded

Do not paint the following unless indicated otherwise.

- a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.
- b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, and chases.
- c. Steel to be embedded in concrete.
- d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

1.11.3 Exterior Painting

Includes new surfaces of the building and appurtenances as indicated. Also included are existing coated surfaces made bare by cleaning operations.

1.11.4 Interior Painting

Includes new surfaces of the building and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

- a. Exposed columns, girders, beams, joists, and metal deck; and
- b. Other contiguous surfaces.

1.11.5 Mechanical and Electrical Painting

Includes field coating of new surfaces.

- a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.
 - (1) Exposed piping, conduit, and ductwork;
 - (2) Supports, hangers, air grilles, and registers;
 - (3) Miscellaneous metalwork and insulation coverings.
- b. Do not paint the following, unless indicated otherwise:
 - (1) New zinc-coated, aluminum, and copper surfaces under insulation.

1.11.6 Exterior Painting of Site Work Items

Field coat the following items:

New Surfaces

- a. Exit Columns
- b. Exit Doors and Frames
- c. Exit Window Frames

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3.

2.1.1 Latex Block Filler

CID A-A-1500.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other substances deleterious to coating performance as specified for each substrate.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Aluminum, Other Non-Galvanized, and Non-Ferrous Surfaces

- a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

- a. Surface Cleaning: Remove the following deleterious substances.

- (1) Dirt, Chalking, Grease, and Oil: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.

- (2) Fungus and Mold: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

- (3) Paint and Loose Particles: Remove by wire brushing.

- (4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

- b. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

- c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board, Plaster, and Stucco

- a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material.

- b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

- c. Allowable Moisture Content: Latex coatings may be applied to damp

surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum instrument measured moisture content of 8 percent. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 APPLICATION

3.5.1 Coating Application

Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein. Thoroughly work coating materials into joints, crevices, and open spaces. Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

- a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.
- b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.
- c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.
- d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied while the intermediate coat is still tacky, within a few days. Otherwise, apply a mist-coat of 1 to 2 wet mils of MIL-P-24441/20 and allow to cure to tack, a minimum of 4 hours, before top coating.

3.5.2 Equipment

Apply coatings with approved brushes, approved rollers, or approved spray equipment, unless specified otherwise. Spray areas made inaccessible to brushing by items such as ducts and other equipment.

3.5.3 Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

3.5.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

1	Exterior Metal Surfaces
2	Interior Metal Surfaces
3	Building Systems Surfaces: Interior and Exterior
4	Exterior Concrete, Concrete Masonry, Stucco, and Asbestos-Cement Surfaces
5	Interior Concrete, Concrete Masonry and Wallboard Surfaces

- b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness. The DFT range specified for MIL-C-24667 represents minimum peak and valley measurements.
- c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.
- d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:
- (1) One coat of primer.
 - (2) One coat of undercoat or intermediate coat.
 - (3) One topcoat to match adjacent surfaces.
- e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.6 COATING SYSTEMS FOR METAL

- a. Primer: Apply specified ferrous metal primer on the same day that surface is cleaned. If flash rusting occurs, re-clean the surface prior to application of primer.
- (1) Inaccessible Surfaces: Prior to erection, use two coats of specified primer on metal surfaces that will be inaccessible after erection.
 - (2) Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field

primer.

(3) Surface Previously Coated with Epoxy or Urethane: Apply MIL-P-24441/1, Formula 150, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

(4) Pipes and Tubing: Semitransparent film applied to pipes and tubing at the mill is not to be considered a shop coat. Remove shop coat and apply specified ferrous metal primer prior to application of subsequent coats.

(5) Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer, CID A-A-50557.

- b. Apply coatings of Tables 1, 2 and 3. "DFT" means dry film thickness in mils.

3.7 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables 4 and 5.

3.8 COATING SYSTEMS FOR WOOD

- a. Apply coatings of Tables 6 and 7.
- b. Prior to erection, apply two coats of specified primer to treat and prime wood surfaces which will be inaccessible after erection.
- c. Apply stains in accordance with manufacturer's printed instructions.

3.9 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow. Use black stencil paint, CID A-A-1558.

3.10 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

TABLE 1

EXTERIOR METAL SURFACES

A. New Steel that has been blast-cleaned (up to SSPC SP 6):

Primer:	FS TT-P-645	1.5 mils DFT
Intermediate:	CID A-A-2962 Class A, Grade C	1.5 mils DFT
Topcoat:	CID A-A-2962 Class A, Grade C	1.5 mils DFT

B. New steel blasted to SSPC SP 10:

Primer:	MIL-P-24441 /1 Formula 150 Type II	3.0 mils DFT
Intermediate:	MIL-P-24441 /1 Formula 152 Type II	3.0 mils DFT
Topcoat:	MIL-PRF-85285	2.0 mils DFT

TABLE 2

INTERIOR METAL SURFACES

A. Metal (except floors) not otherwise specified:

Primer		
- (non-shop-primed surfaces):	FS TT-P-664	2.0 mils DFT
Intermediate:	CID A-A-50574	1.5 mils DFT
Topcoat:	CID A-A-50574	1.5 mils DFT

B. Metal in toilets and other high-humidity areas:

Primer:	FS TT-P-645	2.0 mils DFT
(1 coat on shop-primed surfaces; 2 coats on non-shop-primed)		
Intermediate:	CID A-A-50574	1.5 mils DFT
Topcoat:	CID A-A-50574	1.5 mils DFT

TABLE 3

BUILDING SYSTEMS SURFACES: INTERIOR AND EXTERIOR

Mechanical, electrical, and miscellaneous metal items, except hot metal surfaces and new prefinished equipment.

A. Surfaces not adjacent to painted surfaces:

Primer:	FS TT-P-645	2.0 mils DFT
Intermediate:	FS TT-E-1593	1.5 mils DFT
Topcoat:	FS TT-E-1593	1.5 mils DFT

B. Surfaces adjacent to painted surfaces: Coating systems as specified.
Color of topcoat to match adjacent surfaces: 0.0375 mm DFT for each coat.

TABLE 3

BUILDING SYSTEMS SURFACES: INTERIOR AND EXTERIOR

C. Insulation and surfaces of insulation coverings:

Primer:	N/A	
Intermediate:	FS TT-P-19	1.5 mils DFT
Topcoat:	FS TT-P-19	1.5 mils DFT

TABLE 4

EXTERIOR CONCRETE MASONRY

A. New concrete masonry on uncoated surface:

Primer:	CID A-A-1500	
Intermediate:	FS TT-P-19	1.5 mils DFT
Topcoat:	FS TT-P-19	1.5 mils DFT

NOTE: Sufficient coats to provide no less than 20 mils of finished coating system. Texture: sand

TABLE 5

INTERIOR CONCRETE, CONCRETE MASONRY, AND WALLBOARD SURFACES

A. Concrete ceilings, uncoated:

Primer:	As recommended by manufacturer of FS TT-C-555
Intermediate:	FS TT-C-555 Type I (see note)
Topcoat:	FS TT-C-555 Type I (see note)

NOTE: Sufficient coats to provide no less than 20 mils of finished coating system. Texture: sand

TABLE 7

INTERIOR WOOD AND PLYWOOD SURFACES

A. Wood and plywood not otherwise specified:

Primer:	CID A-A-2335 on softwood plywood	1.5 mils DFT
Intermediate:	CID A-A-50574 semigloss	1.5 mils DFT
Topcoat:	CID A-A-50574 semigloss	1.5 mils DFT

B. Wood surfaces in toilets and other high humidity areas:

Primer:	CID A-A-2994	1.5 mils DFT
Intermediate:	N/A	
Topcoat:		

TABLE 7

INTERIOR WOOD AND PLYWOOD SURFACES
FS TT-E-506 1.5 mils DFT

-- End of Section --

SECTION 10505

STEEL CLOTHING LOCKERS

09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	(1997) Commercial Quality (CS) Steel, Carbon, (0.15 Maximum Percent) Cold-Rolled
ASTM A 569/A 569M	(1998) Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial
ASTM A 653/A 653M	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 456	(1995) Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
ASTM D 2092	(1995) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting

FEDERAL SPECIFICATIONS (FS)

FS AA-L-00486	(Rev. J) Lockers, Clothing, Steel
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MILITARY SPECIFICATIONS (MIL)

MIL-C-22750	(Rev. F) Coating, Epoxy, High Solids
MIL-P-23377	(Rev. G) Primer Coatings: Epoxy, Chemical and Solvent Resistant

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Types; G

Location; G

Installation

Numbering system

SD-03 Product Data

Material

Finish

Locker components

Assembly instructions

SD-04 Samples

Color chips; G

1.3 DELIVERY, HANDLING, AND STORAGE

Deliver lockers and associated materials in their original packages, containers, or bundles bearing the manufacturer's name and the name of the material. Protect from weather, soil, and damage during delivery, storage, and construction.

1.4 FIELD MEASUREMENTS

To ensure proper fits, make field measurements prior to the preparation of drawings and fabrication.

1.5 QUALITY ASSURANCE

1.5.1 Color Chips

Provide a minimum of three color chips, not less than 3 inches square, of each color indicated.

PART 2 PRODUCTS

2.1 TYPES

FS AA-L-00486. Provide Type II, double-tier, Style 1 lockers in the location, quantities and size indicated. Provide locker finish color as indicated. Provide lockers "set-up".

2.2 MATERIAL

2.2.1 Galvanized Steel Sheet

ASTM A 653/A 653M, commercial quality, minimized spangle, galvanized steel sheet with not less than G60 zinc coating. Prepare surface of sheet for painting in accordance with ASTM D 2092, Method A. Minimum uncoated sheet

thickness as specified.

2.2.2 Finish

FS AA-L-00486.

2.2.2.1 Color

As selected.

2.3 COMPONENTS

2.3.1 Built-In Locks

FS AA-L-00486. Provide a padlock eye in the door latching mechanism.

Built-in locks are not required.

2.3.2 Coat Hooks

FS AA-L-00486, zinc plated.

2.3.3 Hanger Rods

FS AA-L-00486.

2.3.4 Door Handles

FS AA-L-00486. Provide zinc alloy or steel handles with a chromium coating.

2.3.5 Doors

FS AA-L-00486, not less than 0.0598 inch thick steel sheet.

2.3.5.1 Hinges

In addition to the requirements of FS AA-L-00486, provide 5-knuckle hinges, minimum 2 inches high. Fabricate knuckle hinges from not less than 0.0747 inch thick steel sheet.

2.3.5.2 Latching Mechanisms

FS AA-L-00486.

2.3.6 Latch Strikes

FS AA-L-00486. Fabricate from not less than 0.0747 inch thick steel sheet, except latch strike may be continuous from top to bottom and fabricated as part of the door framing.

2.3.7 Silencers

FS AA-L-00486.

2.3.8 Back and Side Panels, Tops, and Bottoms

FS AA-L-00486, not less than 0.0474 inch thick steel sheet.

2.3.9 Shelves

FS AA-L-00486. Fabricate from not less than 0.0598 inch thick steel sheet.

2.3.10 Base Panels

FS AA-L-00486.

2.3.11 Number Plates

FS AA-L-00486. Aluminum. Provide consecutive numbers from 1 to 4.

2.3.12 Fastening Devices

Provide bolts, nuts, and rivets as specified in FS AA-L-00486.

PART 3 EXECUTION

3.1 ASSEMBLY AND INSTALLATION

Assemble lockers according to the locker manufacturer's instructions. Align lockers horizontally and vertically. Bolt adjacent lockers together. Adjust doors to operate freely without sticking or binding and to ensure they close tightly.

3.2 NUMBERING SYSTEM

Install number plates on lockers consecutively as indicated .

3.3 FIELD QUALITY CONTROL

3.3.1 Testing

Government may request performance-characteristic tests on assembled lockers in accordance with FS AA-L-00486. Lockers not conforming will be rejected.

3.3.2 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

3.3.3 Cleaning

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner. Remove equipment, surplus materials, and rubbish from the site.

-- End of Section --

SECTION 10800

TOILET AND BATH ACCESSORIES
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-2380	Dispenser, Paper Towel
CID A-A-2524	Holder, Toilet Paper (Single Roll)
CID A-A-2668	Dispenser, Toilet Paper, Cabinet

FEDERAL SPECIFICATIONS (FS)

FS W-H-50	(Rev. B) Hand Drier, Blower, Electric
FS DD-M-411	(Rev. C) Mirrors, Glass

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Manufactured units

Submit for each type of accessory specified. Include descriptions of materials, finishes, fastening and anchoring devices, and appurtenances.

SD-04 Samples

Manufactured units

Submit one of each type of accessory complete with appurtenances and finished as specified. Approved samples may be installed in the work provided each sample is labeled for identification and location recorded.

SD-07 Certificates

Manufactured units

Submit for each type of accessory specified, attesting that materials meet the specified requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in unopened containers, labeled with the manufacturer's names and brands, ready for installation. Store accessories in safe, dry locations until needed for installation.

PART 2 PRODUCTS

2.1 MATERIALS AND FABRICATION

Fabricate accessories in accordance with commercial practice, with welds ground smooth. Bend, flange, draw, form, and perform similar operations in a manner to ensure no defects. Flanges of recessed accessories to return to walls to provide a continuous, tight-against-the-wall installation. Doors shall be warp free. Key manufacturer's standard locks alike, for groups of accessories; two keys furnished for each group.

2.2 FINISHES

Finishes on metals not specified otherwise shall be provided as follows:

<u>Meta</u>	<u>Finish</u>
Corrosion-resisting Steel (Stainless Steel)	General-purpose Polished
Aluminum	Satin Anodic, Clear
Carbon Steel	Bright Chromium Plate
Copper Alloy (Brass)	Bright Chromium Plate
Zinc Alloy	Bright Chromium Plate

2.3 MANUFACTURED UNITS

2.3.1 Toilet Tissue Dispensers (Surface Mounted)

2.3.1.1 Type I, Roller Mounted on Two Support Brackets

CID A-A-2524, spring actuated stainless steel roller. Stainless steel posts.

2.3.1.2 Type II, Two Rolls of Tissue, Vertical Mount

CID A-A-2668, stainless steel .

2.3.2 Paper Towel Dispenser (Surface Mounted)

CID A-A-2380, stainless steel.

2.3.2.1 Type I (Single-Fold Towels)

Minimum thickness of uncoated metal 0.029 inch. Satin finish stainless steel.

2.3.3 Sanitary Napkin Disposal Units, Wall Mounted

Surface-mounted, closed containers with a fixed or folding utility shelf; the shelves and containers fabricated of stainless steel not lighter than 24 gage. The containers are approximately 9 inches wide by 11 inches high by 4 1/2 inches deep. The shelves shall be approximately 8 inches wide by 4 inches deep. Provide top container hinged door, and bottom hinged access door for removal of contents. Liners of the manufacturer's standard type shall be furnished. Surfaces that will be exposed after the units are installed shall have a satin finish.

2.3.4 Waste Receptacles

Provide stainless steel. Finish polished stainless steel. Provide reuseable liner of the type standard with the receptacle manufacturer.

2.3.4.1 Mounting S, Surface Mounting

Capacity shall be not less than 2 cubic feet.

2.3.5 Towel Bars

Surface mounted. Length 24 inches. Provide bars of minimum thickness stainless steel, 0.015 inch.

2.3.6 Soap Holder, Surface Mounted

Copper alloy, corrosion-resisting steel, or aluminum alloy. Holders are formed with integral supports or without any support other than the holder itself. Provide plastic soap dish with drain holes.

2.3.7 Robe Hooks

Provide two hooks integral with the wall flange. Projection shall be not less than 1 5/8 inches from the back of the wall flange to the end of the hooks. Hooks shall be stainless steel, copper alloy, or aluminum alloy.

2.3.8 Soap Dispensers

Lather dispersed by spring action "push-in" valve, capacity of 10 fluid ounces of stainless steel.

2.3.9 Mirrors

Class 2, Style E, Grade 1, electrocopper plated, conforming to FS DD-M-411, size as indicated.

2.3.10 Electric Hand Drier

FS W-H-50.

PART 3 EXECUTION

3.1 INSTALLATION

Surfaces of fastening devices exposed after installation shall have the same finish as the attached accessory. Exposed screw heads shall be oval. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses.

After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1.1 Surface Mounted Accessories

Mount on concealed backplate, unless specified otherwise. Accessories without backplate shall have concealed fasteners. Unless indicated or specified otherwise, install accessories with sheet metal screws or wood screws in lead-lined braided jute, Teflon or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplate in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplate secured to metal studs.

-- End of Section --

SECTION 11020

SECURITY VAULT DOOR
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS AA-D-00600 (Rev. C; Int Am. 4) Door, Vault Security

1.2 GENERAL REQUIREMENTS

The vault door unit shall be a steel security-vault type door with frame, , and ramp type threshold, and shall be a standard product of a manufacturer specializing in this type of fabrication.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Security vault doors; G

Show head, jamb, and sill sections, and elevations of the doors.

SD-03 Product Data

Security vault doors; G

SD-08 Manufacturer's Instructions

Installation

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver door and frame assemblies to the jobsite in a protective covering, with barcode label showing national stock number of the vault door unit. Inspect materials delivered to the jobsite for damage. Unload with a minimum of handling. Store in a dry location with adequate ventilation, free from dust, water, and other contaminants, and which permits easy access for inspection and handling. Store door assemblies off the floor on nonabsorptive strips or wood platforms. Replace damaged items that cannot be restored to like-new condition.

PART 2 PRODUCTS

2.1 SECURITY VAULT DOORS AND FRAMES

Provide vault door, GSA labeled, in accordance with FS AA-D-00600. Provide Class 5, Type IL-left opening swing with optical device , Style K - key change combination lock, Design B - no exterior hardware. The optical device shall permit observation from the inside to the outside of the vault.

PART 3 EXECUTION

3.1 INSTALLATION

Install vault door assembly in strict compliance with manufacturer's printed instructions and drawings. Adjust door, locking mechanism, and inner escape device for proper operation.

-- End of Section --

SECTION 13852

INTERIOR FIRE DETECTION AND ALARM SYSTEM
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	(1994) Rigid Steel Conduit - Zinc Coated
ANSI C80.3	(1994) Electrical Metallic Tubing - Zinc Coated

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI A17.1	(1996; Addenda 1997) Safety Code for Elevators and Escalators
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BUILDERS HARDWARE MANUFACTURERS ASSOCIATION, INC. (BHMA)

ANSI/BHMA A156.15	(1995) Closer Holder Release Devices
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FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825	(1999) Approval Guide
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 72	(1996) National Fire Alarm Code
NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES INC. (UL)

UL FPED	(1999) Fire Protection Equipment Directory
UL 5	(1996; R 1998) Surface Metal Raceways and Fittings

UL 6	(1997; R 1999) Rigid Metal Conduit
UL 467	(1993; R 1999) Grounding and Bonding Equipment
UL 497B	(1999) Safety Protectors for Data Communications and Fire Alarm Circuits
UL 514A	(1996; R 1999) Metallic Outlet Boxes
UL 514B	(1997; R 1998) Fittings for Cable and Conduit
UL 797	(1993; R 1997) Electrical Metallic Tubing
UL 1242	(1996; R 1998) Intermediate Metal Conduit
UL 1449	(1996; R 2000) Transient Voltage Surge Suppressors
UL 1971	(1995; R 1997) Safety Signaling Devices for the Hearing Impaired

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods" applies to this section with additions and modifications specified herein.

1.3 DESCRIPTION OF WORK

The work includes providing new interior fire alarm system including material, tools, equipment, installation, and testing necessary for and incidental to the provision of a complete and usable standard system conforming to the applicable requirements of NFPA 70 and NFPA 72 and this specification. In referenced NFPA publications, the advisory provisions shall be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Fire Protection Engineer. Equipment and devices shall be compatible and operable in all respects with, and shall in no way impair reliability or operational functions of, the existing base fire alarm system. Existing base fire alarm system is a King-Fisher Co. radio system. Materials and equipment to be furnished under this contract shall be King-Fisher Co. KFRTI-20 system. No other panel will be acceptable.

1.4 DEFINITIONS

Year 2000 compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.5 SYSTEM DESCRIPTION

1.5.1 Design Requirements

1.5.1.1 Power Calculations

Submit design calculations to substantiate that the battery capacity exceeds supervisory and alarm power requirements. Show comparison of the detector power requirements per zone versus the control panel smoke detector power output per zone in both the standby and alarm modes. Show comparison of the notification appliance circuit alarm power requirements with the rated circuit power output.

1.6 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures". The Engineering Field Activity Chesapeake (EFA), Naval Facilities Engineering Command, Fire Protection Engineer will review for approval all submittals required by this section.

SD-02 Shop Drawings

System floor plans; G

System wiring diagrams; G

Conductor wire marker schedule; G

SD-03 Product Data

Control panel and modules (combination radio transmitter, interface panel, control panel and annunciator); G

Storage batteries; G

Battery charger; G

Manual pull stations; G

Open-area (spot-type) smoke detectors; G

Alarm horns; G

Visible appliances; G

Wiring; G

Ground rods

Conduit

Outlet boxes

Fittings for conduit and outlet boxes

Surge suppression devices; G

Data which describe more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Submit one original for each item and clear, legible, first-generation photocopies for the remainder of the specified copies. Incomplete or illegible photocopies will not be accepted. Partial submittals will not be accepted.

SD-05 Design Data

Power calculations; G

SD-06 Test Reports

Open-area (spot-type) 2-wire smoke detectors; G

Preliminary testing; G

Final acceptance testing; G

Submit for all inspections and tests specified under paragraph entitled "Field Quality Control."

SD-07 Certificates

Qualifications of installer; G

Qualifications of System Technician

Year 2000 (Y2K) Compliance Warranty

SD-10 Operation and Maintenance Data

Fire alarm system, Data Package 5; G

SD-11 Closeout Submittals

System as-built drawings; G

1.7 QUALITY ASSURANCE

1.7.1 Qualifications of Installer

The Contractor or installer shall have satisfactorily installed fire alarm systems of the same type and design as specified herein.

Prior to commencing fire alarm system work, submit data showing that the Contractor or installer has satisfactorily installed three fire alarm systems of the same type and design as specified herein within the past three years.

For each system installed, submit the following:

- a. A detailed summary of the type and design of the system;
- b. The contract name or number, completion date of the project and total cost of the system;
- c. The name and telephone number of the facility or installation for whom the work was performed; and,
- d. The name and telephone number of a supervisory level point of contact at the facility or installation who has knowledge of the performance of the Contractor's or installer's work.

1.7.2 Manufacturer's Representative

Provide the services of a representative or technician from the manufacturer of the system, experienced in the installation and operation of the type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of the system and to provide instruction to Government personnel.

1.7.3 Qualifications of System Technician

Installation drawings, shop drawings and as-built drawings shall be prepared by, or under the supervision of, a qualified technician. Qualified technician shall be an individual who is experienced with the types of work specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level III certification in fire alarm system program. Contractor shall submit data showing the name and certification of the technician at or prior to submittal of drawings.

1.7.4 Drawing Requirements

1.7.4.1 System Floor Plans

Submit shop drawings of the system floor plans showing locations of initiating and indicating appliances and end-of-line supervisory devices. Show wire color coding, wire counts, and device wiring order. Show candela rating of each visible notification appliance.

1.7.4.2 System Wiring Diagrams

Submit complete wiring diagrams of the system showing points of connection and terminals used for all electrical connections in the system. Show all modules, relays, switches and lamps in the control panel.

1.7.4.3 System As-Built Drawings

Upon completion, and before final acceptance of the work, furnish to the Contracting Officer one complete set of as-built drawings of the system. The as-built drawings shall be "D" size 34 by 22 inches reproducible drawings on mylar film drawn to the same scale as the contract drawings and

with title block similar to contract drawings. The as-built drawings shall be furnished in addition to the record drawings required by Division 01.

1.7.5 UL Listing or FM Approval

Submit copies of UL listing or FM approval data showing compatibility of the smoke detector model being provided with the control panel being provided, if 2-wire detectors are proposed for use.

1.8 WARRANTY

1.8.1 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component" provide a statement of Y2K compliance warranty for the specific equipment. The contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations to the extent that other computer controlled components, used in combination with the computer controlled component being acquired, properly exchange data and time data with it. If the contract requires that specific listed products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provisions to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

1.9 MAINTENANCE

1.9.1 Spare Parts

Furnish the following spare parts:

- a. 5 complete sets of system keys
- b. 1 of each type of audible and visual alarm device installed
- c. 2 of each type of fuse required by the system
- d. 1 of each type of smoke detector base and head installed
- e. 1 smoke detector manufacturer's test screen, card or magnet for each 10 detectors, or fraction thereof, installed in the system

1.9.2 Manuals

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data." Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the location of the building, the name of the Contractor, system manufacturer and the contract number. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: circuit drawings; wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shutdown instructions; installation instructions; maintenance instructions; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list.

PART 2 PRODUCTS

2.1 Y2K COMPLIANT PRODUCTS

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, control panel with annunciator interface and radio transmitter, fire detection and suppression systems, utilizing microcomputer, or minicomputer.

2.2 SYSTEM DESIGN

2.2.1 Operation

Provide a complete, electrically supervised, code 3 temporal common coded, manual zoned, annunciated, fire alarm system as described herein, and as shown on the drawings. Provide separate circuits from the control panel to each zone of initiating devices as specified herein. Transmission of signals from more than one zone over a common circuit to the control panel is prohibited.

2.2.1.1 Fire Alarm Signal Initiation

Operation shall be such that actuation of any:

- a. Manual station
- b. Smoke detector
- c. Automatic fire sprinkler system

Shall cause all of the following actions:

- a. All building evacuation alarm devices (notification appliances) to operate continuously;
- b. The annunciator to properly register;

- c. A coded signal to be transmitted over the station fire alarm system;

All operations shall remain in the alarm mode (except alarm notification appliances if manually silenced) until the system is manually restored to normal.

2.2.1.2 Supervisory Signal Initiation

Operation of a sprinkler control valve tamper or low air pressure supervisory switch shall not cause an alarm, but shall cause operation of common system audible trouble signal, and display of a visual indication distinct from that displayed to indicate a fire alarm or a fault in the supervisory circuit, and transmission of a distinct supervisory signal to fire alarm headquarters.

2.2.1.3 Monitoring Integrity of Installation Conductors

All system circuits shall be electrically monitored for integrity including the following:

- a. Initiating circuits.
- b. Evacuation alarm (notification appliance) circuits (including both audible and visual notification appliances).
- c. Battery power supply (low and no voltage across the standby battery terminals and open battery circuit).
- d. Radio tripping circuits.

Provide Class B initiating device circuits, and Class B notification appliance circuits as defined by NFPA 72. A ground fault condition or single break in any other circuit shall cause operation of the system trouble signals. Loss of AC power, abnormal AC voltage, a break in the standby battery power circuit, or low battery voltage shall also cause operation of system trouble signals. The abnormal position of any switch in the control panel shall also cause operation of the system trouble signals. Audible and visual equipment for supervision of the AC power supply shall be energized from the auxiliary DC power supply and vice versa. Trouble signals shall sound continuously until manually silenced or the system has been restored to normal.

2.2.2 Primary Power

Primary power source shall be 120 volts AC service, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all initiating device, notification appliance, signaling line, trouble signal and radio transmitter tripping circuits. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the rated output of the system power supply module(s). Obtain AC operating power as shown on contract drawings.

2.2.3 Auxiliary Power

Provide secondary DC power supply for operation of system in the event of failure of the AC source. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm. Loss of AC power shall not prevent transmission of a signal to station fire alarm headquarters upon operation of any initiating circuit.

2.2.3.1 Storage Batteries

Provide sealed lead calcium batteries and charger. Drycell batteries are not acceptable. House batteries in the control panel. Provide batteries of adequate ampere-hour rating to operate the system, including audible trouble signal devices, and radio auxiliary transmitter tripping circuits under supervisory conditions for 60 hours, at the end of which time batteries shall be capable of operating the entire system in a full alarm condition for not less than 15 minutes. Provide calculations substantiating the battery capacity. Provide reliable separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts.

2.2.3.2 Battery Charger

Provide completely automatic high/low charging rate type capable of recovery of the batteries from full discharge to full charge in 24 hours or less. Provide an ammeter to indicate rate of charge and a voltmeter to indicate the state of battery charge under load. Meters shall be factory installed, or factory-supplied plug-in modules. Field installation of meters other than the panel manufacturer's plug-in modules is prohibited. Provide a trouble light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided. House charger in the control panel or battery cabinet.

2.3 COMPONENT DESIGN

2.3.1 Control Panel

The control panel shall be a King-Fisher Co. Model KFRTI-20 with radio fire alarm reporting and battery back-up. No other product shall be acceptable. The panel shall be self-contained and designed for detecting the operation of any approved signal initiating device, indicating by annunciator LEDs the area of the alarm and/or trouble condition, and operate all alarm and auxiliary devices. The panel shall have 8 zones as indicated. The panel shall be capable of accepting zone cards in increments of four zones per card for class B applications, or two zones per card for class A application. The panel shall have automatic radio reporting for alarms, supervisory, and trouble conditions with "True Interrogate" test status reporting for use with an approved compatible radio alarm receiving unit.

The panel housing shall be a Nema 3R rainproof locked enclosure. All electronic boards shall be mounted on a removable sub-plate. A lexan viewing window displaying common and zone status conditions shall be mounted on the front door. All electronic circuitry shall be solid state. C-MOS Logic installed on top quality epoxy glass printed circuit boards

with gold plated connectors for all ribbon, edge, and battery connectors. The operating temperature range of all components shall be -40 degrees F to +140 degrees F (-40 degrees C to +60 degrees C).

The panel shall, as a minimum, contain the following features: When one or more of the zone initiating devices latches the panel into an alarm condition, the panel shall begin an alarm condition sequence which will pulse the respective individual zones RED alarm LED, pulse the common RED alarm LED, activate the alarm indicating devices, and transmit the appropriate zones to the central receiving unit. The panel shall provide full supervision of the field wiring for each initiating zone and each audible indicating circuit. A detected fault shall light the amber trouble LED for the zone in trouble, pulse the amber common trouble LED on the alarm control board, and pulse the internal panel trouble buzzer, and transmit the appropriate zones to the central receiving unit. In addition to the above, the panel shall monitor its own operational status for: system trouble, improper board insertion, control switches or cables abnormal, audible circuit trouble (opens or short circuits), ground fault condition, loss of primary power, and battery circuit trouble.

A minimum of six controls shall be available for silencing, restoration, and testing of the panel. The six controls shall be alarm silence, trouble silence, acknowledge, reset, drill, and lamp test.

The panel shall operate directly from 120 VAC line voltage, and in the event of AC power outages, automatically switch to a 24 volt DC back-up battery power supply. Loss of AC power shall not cause a trouble signal until 1-2 minutes after failure.

The panel shall have a radio reporting system including: antenna, coaxial cable, and two modular plug-in printed circuit boards.

2.3.1.1 Initiating Zones

Arrange as shown.

2.3.2 Manual Pull Stations

Provide noncoded single action type with mechanical reset features. Stations shall be semi-flush mounted and interior type as indicated unless otherwise indicated. Equip each station with a terminal strip with contacts of proper number and type to perform functions required. Stations shall be a type not subject to operation by jarring or vibration. Break-glass-front stations are not permitted; however, a pull-lever break-rod type is acceptable provided presence of rod is not required to reset station. Station color shall be red. Station shall provide visible indication of operation. Restoration shall require use of a key. Keys shall be identical throughout the system for all stations and control panel(s). Mount stations with operating lever not more than 4 feet above finished floor. Where weatherproof stations are required, provide stations with cast metal, weatherproof (NEMA 3R) housings with hinged access doors; finish housings with red enamel paint and provide permanently affixed engraved or raised-letter plastic or metal identification signs reading "FIRE ALARM" with white letters a minimum of 3/4 inch high.

2.3.3 Open-Area (Spot-Type) Smoke Detectors

Provide detectors designed for detection of abnormal smoke densities by the photoelectric principle. Detectors shall be 4-wire or 2-wire type. Provide necessary control and power modules required for operation integral with the control panel. Detectors and associated modules shall be compatible with the control panel and shall be suitable for use in a supervised circuit. Malfunction of the electrical circuits to the detector or its control or power units shall result in the operation of the system trouble signals. Each detector shall contain a visible indicator lamp that shall flash when the detector is in the normal standby mode and shall glow continuously when the detector is activated. Each detector shall be the plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which the detector base contains screw terminals for making all wiring connections. Detector head shall be removable from its base without disconnecting any wires. Removal of detector head from its base shall cause activation of system trouble signals. Each detector shall be screened to prevent the entrance of insects into the detection chamber(s).

2.3.3.1 4-Wire Smoke Detectors

Detector circuits shall be of the 4-wire type whereby the detector operating power is transmitted over conductors separate from the initiating circuit. Provide a separate, fused, power circuit for each smoke detection initiating circuit (zone). Failure of the power circuit shall be indicated as a trouble condition on the corresponding initiating circuit.

2.3.3.2 2-Wire Smoke Detectors

Detector circuits of the 2-wire type whereby the detector operating power is transmitted over the initiating circuit are permitted, provided the detectors used are approved by the control panel manufacturer for use with the control panel provided and are UL listed or FM approved as being compatible with the control panel (copies of the UL or FM listings showing compatibility shall be submitted as specified in paragraph entitled "Submittals"). The total number of detectors on any detection circuit shall not exceed 80 percent of the maximum number of detectors allowed by the control panel manufacturer for that circuit. Additional zones above those specified in the paragraph titled "Initiating Zones" shall be provided if required to meet the above requirements. Calculations showing compliance with the power consumption limitation requirements shall be submitted with the calculations required by the paragraph entitled "Design Data." The manufacturer's data submitted under the paragraph entitled "Manufacturer's Catalog Data" shall clearly indicate the compatibility of the detectors with the control panel provided and the maximum number of detectors permitted per zone.

2.3.3.3 Photoelectric Detectors

Operate on the light scattering principle using a LED light source. Detector shall respond to both flaming and smoldering fires.

2.3.3.4 Detector Spacing and Location

Detector spacing and location shall be in accordance with the manufacturer's recommendations and the requirements of NFPA 72, except provide at least two detectors in all rooms of 600 square feet or larger in area. In no case shall spacing exceed 30 by 30 feet per detector. Detectors shall not be placed closer than 5 feet from any air discharge or return grille, nor closer than 12 inches to any part of any lighting fixture. In areas without finished ceilings, mount detectors at the underside of deck above unless otherwise indicated.

2.3.4 Notification Appliances

Provide in accordance with NFPA 72 and as indicated. Do not exceed 80 percent of the listed rating in amperes of any notification appliance circuit. Additional circuits above those shown shall be provided if required to meet this requirement. Submit calculations showing compliance with the above power consumption requirements with the calculations required by the paragraph titled "Design Data". Effective sound levels shall comply with NFPA 72. Provide appliances in addition to those shown if required in order to meet NFPA 72 sound level requirements. Provide appliances specifically listed for outdoor use in locations exposed to weather. Finish appliances in red enamel.

2.3.4.1 Alarm Horns

Recessed, grill, vibrating type suitable for use in an electrically supervised circuit and shall have a sound output rating of at least 90 decibels at 10 feet.

2.3.4.2 Visible Appliances

Flush-mounted assembly of the stroboscopic type suitable for use in an electrically supervised circuit and powered from the notification appliance circuit(s). Appliances shall provide a minimum of 15 candela measured in accordance with UL 1971, but in no case less than the effective intensity required by NFPA 72 for the appliance spacing and location. Lamps shall be protected by a thermoplastic lens and labelled "FIRE" in letters at least 1/2 inch high. Provide visible appliances and as indicated. Visible appliances may be part of an audio-visual assembly. Where more than two appliances are located in the same room or corridor, provide synchronized operation.

2.3.5 Fire Extinguishing Systems

Activation shall cause complete functional operation of the control panel. System contacts are specified in other sections.

2.3.6 Grounding

Ground each antenna system and fire alarm control panel by connection from the grounding terminal connection of the box to either a driven ground rod or a buried, metallic water pipe. Resistance to ground shall not exceed 10 ohms. Ground rods shall be the sectional type, copper-encased steel, with a

minimum diameter of 3/4 inch and a total length of 10 feet conforming to UL 467. The rods shall have a hard, clean, smooth, continuous copper surface throughout the length of the rod. The copper shall have a minimum wall thickness of 0.013 inch at any point on the rod. Ground rods shall not protrude more than 3 inches above grade.

2.3.7 Conduit

2.3.7.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1 or UL 6.

2.3.7.2 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.3.7.3 Electrical Metallic Tubing (EMT)

ANSI C80.3 or UL 797.

2.3.8 Outlet Boxes

UL 514A, zinc-coated steel.

2.3.9 Fittings for Conduit and Outlet Boxes

UL 514B, zinc-coated steel.

2.3.10 Wiring

NFPA 70 and NFPA 72. Wire for 120V circuits shall be No. 12 AWG minimum solid copper conductor. Wire for low voltage DC circuits shall be No. 14 AWG minimum solid copper conductor. Insulation shall be 75 degree C minimum with nylon jacket. Color code all wiring.

2.4 SURGE SUPPRESSION

Provide line voltage surge suppression devices to suppress all voltage transients which might damage the control panel and transmitter components. Mount suppressors in separate enclosure(s) adjacent to control panel unless suppressors are specifically UL listed or FM approved for mounting inside the control panel provided and approved for such use by the control panel manufacturer.

2.4.1 Line Voltage Surge Suppressor

Suppressor shall be UL 1449 listed with a maximum 330 volt clamping level and a maximum response time of 5 nanoseconds. Suppressor shall also meet IEEE C62.41 category B tests for surge capacity. Suppressor shall be a multi-stage construction which includes inductors and silicon avalanche zener diodes. Suppressor shall have a long-life indicating lamp (light emitting diode or neon lamp) which extinguishes upon failure of protection components. Fuses shall be externally accessible. Wire in series with the incoming power source to the protected equipment using screw terminations.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the requirements of NFPA 70, and NFPA 72. Each conductor used for the same specific function shall be distinctively color coded. Each function color code shall remain consistent throughout the system. Use colors as directed by the Contracting Officer to match existing base color coding scheme. All wiring shall be in steel conduit or electrical metallic tubing. All circuit conductors shall be identified within each enclosure where a tap, splice or termination is made. Conductor identification shall be by plastic coated self sticking printed markers or by heat-shrink type sleeves. The markers shall be attached in a manner that will not permit accidental detachment. Control circuit terminations shall be properly identified. Wire devices so that their removal will activate system trouble signals. Pigtail or "T" tap connections are prohibited. Wiring for DC circuits shall not be permitted in the same conduit or tubing as wiring for AC circuits. Paint all junction box covers red or provide them with permanent labels reading "FIRE ALARM CIRCUIT." Electrical metallic tubing shall not be installed in exterior or wet locations and shall not be imbedded in masonry or concrete. Provide a written schedule of conductor markings identifying each wire marker, the purpose, the origin, and termination point of each conductor. The conductor wire marker schedule shall be turned over to the Contracting Officer at the time of preliminary testing with as built drawings.

3.2 FIELD QUALITY CONTROL

3.2.1 Preliminary Testing

Notify Contracting Officer prior to performing preliminary testing. Contractor shall conduct the following tests during installation of wiring and system components. Any deficiency pertaining to these requirements shall be corrected by the Contractor prior to final acceptance testing of the system. Record results of testing. Submit all test results to the Contracting Officer.

- a. Ground Resistance: Prior to connecting control panel and transmitter, test grounds for ground resistance value. Use a portable ground testing megger to test each ground or group of grounds. Make ground resistance measurements in normally dry weather, not less than 48 hours after a rainfall. Follow the directions provided by the equipment manufacturer for proper use of the equipment. Measure resistance of each connection to ground. Resistance of each connection to ground shall not exceed 10 ohms.
- b. Operation of Entire System. Operate all initiating and indicating devices.
- c. Operation of Supervisory Systems: Operate all portions to demonstrate correctness of installation.

- d. Smoke Detector Test: Clean the smoke detectors in accordance with the manufacturer's recommended procedures. Test smoke detectors using magnet-activated test switch, manufacturer-provided test card, or smoke. Use of aerosol sprays to test smoke detectors is prohibited. When 2-wire smoke detectors are provided, prior to formal inspection and tests, perform sensitivity tests on each smoke detector. Perform voltage activation sensitivity test on each detector and record the results. Remove detectors with a sensitivity level above or below the UL accepted sensitivity range for that detector and replace with new detectors having the UL accepted sensitivity range. Present recorded data at the formal inspection for verification. Approved copies shall become part of the operations and maintenance manual for the fire alarm system.

3.2.2 Final Acceptance Testing

The Contractor shall notify the Contracting Officer when the system is ready for final acceptance testing. Request scheduling for final acceptance testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and the Contracting Officer, and written certification to this effect has been received by the EFA Fire Protection Engineer. The system shall be in service at least 15 calendar days prior to final acceptance testing. The Contractor shall allow at least 15 calendar days between the date final testing is requested and the date the final acceptance testing takes place. The Contractor shall furnish all appliances, equipment, instruments, devices and personnel for this test. Furnish a minimum of three two-way radios plus one additional radio for each remote annunciator, all operating on the same frequency. The system shall be tested for approval in the presence of representatives of the manufacturer, the Contracting Officer, and the EFA Fire Protection Engineer. All necessary tests shall be made including the following, and any deficiency found shall be corrected and the system retested.

3.2.2.1 Entire System

Test the entire system by operating all fire alarm initiating, notification, and signaling devices. Perform tests with the system operating on primary power and repeat the test with the system operating on battery power only. Provide necessary equipment to test smoke detectors.

3.2.2.2 Supervisory Systems

All aspects of the supervisory functions of the systems shall be operated. Introduce faults in each circuit at random locations as directed by the EFA Fire Protection Engineer. Verify proper trouble annunciation at the control panel.

3.2.3 Additional Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system shall be suspended until proper adjustments, corrections or revisions have been made to assure proper

performance of the system. If these revisions require more than a nominal delay, the Contracting Officer shall be notified when the additional work has been completed, to arrange a new inspection and test of the fire alarm system. All tests required shall be repeated prior to final acceptance, unless directed otherwise.

-- End of Section --

SECTION 13935

DRY-PIPE FIRE SPRINKLER SYSTEMS
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI A17.1 (1996; Addenda 1997) Safety Code for
Elevators and Escalators

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C651 (1992) Disinfecting Water Mains

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825 (1999) Approval Guide

FEDERAL SPECIFICATIONS (FS)

FS TT-E-489 (Rev. J) Enamel, Alkyd, Gloss, Low VOC
Content

FS TT-P-664 (Rev. D) Primer Coating, Alkyd,
Corrosion-Inhibiting, Lead and Chromate
Free, VOC-Compliant

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY, INC. (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports -
Materials, Design and Manufacture

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 (1996) Installation of Sprinkler Systems

NFPA 24 (1995) Installation of Private Fire
Service Mains and Their Appurtenances

NFPA 70 (1999) National Electrical Code

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 25 (1991) Red Iron Oxide, Zinc Oxide, Raw

Linseed Oil and Alkyd Primer (Without Lead
and Chromate Pigments)

UNDERWRITERS LABORATORIES INC. (UL)

UL FPED	(1999) Fire Protection Equipment Directory
UL 262	(1994; R 1997) Gate Valves for Fire-Protection Service
UL 789	(1993; R 1994) Indicator Posts for Fire-Protection Service

1.2 SYSTEM DESCRIPTION

Design and provide new automatic dry pipe fire extinguishing sprinkler systems for complete fire protection coverage throughout the building.

1.3 SPRINKLER SYSTEM DESIGN

Design automatic dry pipe fire extinguishing sprinkler systems in accordance with the required and advisory provisions of NFPA 13, hydraulic calculations using the area/density method for uniform distribution of water over the design area for ordinary hazard occupancy. Each system shall include materials, accessories, and equipment inside and outside the building to provide each system complete and ready for use. Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed working drawings to be submitted for approval. Locate sprinkler heads in a consistent pattern with ceiling grid, lights, and air supply diffusers. Devices and equipment for fire protection service shall be UL FPED listed or FM P7825 approved for use in dry pipe sprinkler systems.

1.3.1 Location of Sprinkler Heads

Spacing of sprinklers and position and orientation of sprinklers in relation to the ceiling, walls, and obstructions shall conform to NFPA 13 for ordinary hazard occupancy. Uniformly space sprinklers on the branch piping.

1.3.2 Water Distribution

Distribution shall be uniform throughout the area in which the sprinkler heads will open. Discharge from individual sprinklers in the hydraulically most remote area shall be not less than 100 percent of the specified density.

1.3.3 Density of Application of Water

Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinklers shall be .15 gpm per sq ft.

1.3.4 Sprinkler Design Area

Entire area.

1.3.5 Outside Hose Allowances

Hydraulic calculations shall include an allowance of 500 gpm for outside hose streams.

1.3.6 Friction Losses

Calculate losses in piping in accordance with the Hazen-Williams formula with 'C' value of 100 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping. Velocity in the sprinkler piping shall be limited to a maximum of 20 ft/sec.

1.3.7 Water Supply

Base hydraulic calculations on a static pressure of 86 psig with 908 gpm available at a residual pressure of 78 psig at the junction with the water distribution piping system. Provide 5 psi cushion between total calculated demand and the water supply.

1.3.8 Detail Drawing

Prepare 24 by 36 inch detail working drawings of sprinkler heads and piping system layout in accordance with NFPA 13, "Working Drawings (Plans)." Show data essential for proper installation of each system. Show details, plan view, elevations, and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams. Show location and orientation of sprinkler heads in relation to obstructions.

1.3.9 Detail Drawings

After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes. Submit 24 by 36 inch drawings on reproducible mylar film with title block similar to full size contract drawings. Furnish the as-built (record) working drawings in addition to as-built contract drawings required by Division 1, "General Requirements."

1.4 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures." The Atlantic Division, Naval Facilities Engineering Command, Fire Protection Engineer, will review and approve all submittals in this section requiring Government approval.

SD-02 Shop Drawings

Sprinkler heads and piping system layout; G

Electrical wiring diagrams; G

SD-03 Product Data

Piping; G

Valves, including gate, check, and globe; G

Water motor alarms; G

Sprinkler heads; G

Pipe hangers and supports; G

Fire department connections; G

Low air pressure supervisory switch; G

Dry pipe valves; G

Air compressor; G

Mechanical couplings; G

Backflow Preventers; G

Pressure Switch; G

Annotate descriptive data to show the specific model, type, and size of each item.

SD-05 Design Data

Sprinkler system design; G

Submit computer program generated hydraulic calculations to substantiate compliance with hydraulic design requirements. Calculations generated by computer program shall include the name, address, and telephone number of the software manufacturer.

SD-06 Test Reports

Preliminary tests on piping system; G

SD-07 Certificates

Qualifications of installer; G

SD-10 Operation and Maintenance Data

Dry pipe valves, Data Package 3; G

Air compressor, Data Package 3; G

Submit in accordance with Section 01781, "Operation and

Maintenance Data."

SD-11 Closeout Submittals

As-built drawings of each system; G

1.5 QUALITY ASSURANCE

1.5.1 Qualifications of Installer

Prior to installation, submit data showing that the Contractor has successfully installed systems of the same type and design as specified herein, or that Contractor has a firm contractual agreement with a subcontractor having such required experience. Data shall include names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.

PART 2 PRODUCTS

2.1 ABOVEGROUND PIPING SYSTEMS

Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing pipe fittings; bushings will not be permitted. Perform welding in the shop; field welding will not be permitted. Conceal piping in areas with suspended ceiling.

2.1.1 Sprinkler Piping

NFPA 13, except as modified herein. Steel piping shall be Schedule 10 or 40 for sizes less than 8 inches. Fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded shall be welded, threaded, or grooved-end type. Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into the pipe when pressure is applied will not be permitted. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall be permitted in pipe sizes 1.5 inches and larger. Fittings shall be UL FPED listed or FM P7825 approved for use in dry pipe sprinkler systems. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer. Steel piping with wall thickness less than Schedule 30 shall not be threaded. Steel piping shall be galvanized. Sprinkler pipe and fittings shall be metal.

2.1.2 Sprinkler Heads

Provide nominal 0.50 inch orifice standard response sprinkler heads. No o-rings will be permitted in sprinkler heads. Release element of each head shall be of the ordinary temperature rating or higher as suitable for the specific application. Provide polished stainless steel ceiling plates or chromium-plated finish on copper alloy ceiling plates, and chromium-plated pendent sprinklers below suspended ceilings. Provide corrosion-resistant sprinkler heads and sprinkler head guards as required by NFPA 13 for sprinklers exposed to the elements in Room No. 8. Automatic sprinklers

installed in the pendent position shall be of the dry-pendent type except that standard pendent sprinklers may be installed on return bends when both the sprinklers and the return bends are located in a heated area.

2.1.3 Cabinet

Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each dry pipe valve. The number and types of extra sprinkler heads shall be as specified in NFPA 13.

2.1.4 Dry Pipe Valves

Provide valve complete with accessories and appurtenances for the proper operation of the system.

2.1.5 Water Motor Alarms

Provide alarms of the approved weatherproof and guarded type, to sound locally on the flow of water in each corresponding sprinkler system. Mount alarms on the outside of the outer walls of each building at a location as directed. Provide separate drain piping directly to exterior of building.

2.1.6 Pressure Switch

Provide switch with circuit opener or closer for the automatic transmittal of an alarm over the facility fire alarm system. Connection of switch shall be under Section 13852, "Interior Fire Detection and Alarm System". Do not install a shutoff valve in the piping between the dry pipe valve and any pressure switch.

2.1.7 Low Air Pressure Supervisory Switch

Provide switch for each sprinkler system and connect to building fire alarm system to activate the system supervisory alarm when air pressure in system drops halfway from the normal pressure to the tripping point. Connection of switch shall be under Section 13852, "Interior Fire Detection and Alarm System". Provide a bleeder valve in the air line ahead of the switch for testing operation of the switch. The valve shall be normally open. Closing the valve shall shut off the air supply to the switch and exhaust the pressure between the switch and valve.

2.1.8 Tank Mounted Air Compressor

Provide an approved, automatic type, electric motor-driven air compressor including pressure switch, air piping, and 10 gallon minimum capacity tank. Compressor shall have a minimum capacity capable of charging the complete sprinkler system to normal system air pressure within 30 minutes. Provide an approved automatic air maintenance device for each system.

2.1.9 Pipe Hangers and Supports

Provide in accordance with NFPA 13. Attach to steel joists with MSS SP-58, Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical

web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor.

2.1.10 Valves

NFPA 13. Provide valves of types approved for fire service. Valves shall open by counterclockwise rotation. Provide a wall indicator valve beneath each dry pipe valve. Check valves shall be flanged clear opening swing-check type valves with flanged inspection and access cover plate for sizes 4 inches and larger.

2.1.10.1 Backflow Preventers

Provide double check valve assembly backflow preventer with OS&Y gate valve backflow preventer with OS&Y gate valve on both ends. Each check valve shall have a drain. Backflow prevention assemblies shall have current "Certificate of Approval" from the Foundation For Cross Connection Control and Hydraulic Research FCCCHR-USC. Listing of the specific make, model, design, and size in the FCCCHR-USC shall be acceptable as the required documentation. Provide downstream of the backflow prevention assembly listed hose valves with 2.5 inch National standard male hose threads with cap and chain. Provide one valve for each 250 gpm of system demand or fraction thereof. Provide a permanent sign in accordance with paragraph entitled "Identification Signs" which reads, "Test Valve."

2.1.10.2 Valve Supervision

Provide supervision of each control valve against closure and tampering in accordance with NFPA 13. Provide switch with SPDT (Form C) dry contacts for the automatic transmittal of a supervisory signal over the facility fire alarm system; minimum switch contact rating shall be 2.5 amperes at 24 VDC. A supervisory signal shall be initiated during the first two revolutions of the hand wheel, or during the first 1/5th of travel distance of the valve stem, from the full open position. Connection of the switch shall be under Section 13852, "Interior Fire Detection and Alarm System".

2.1.11 Identification Signs

NFPA 13. Attach properly lettered and approved metal signs to each valve and alarm device. Permanently affix hydraulic design information sign to the riser of each system.

2.1.12 Inspector's Test Connection

Provide test connections approximately 6 feet above the floor for each sprinkler system or portion of each sprinkler system equipped with an alarm device; locate at the hydraulically most remote part of each system. Provide test connection piping to a location where the discharge will be readily visible and where water may be discharged without property damage. Provide discharge orifice of same size as corresponding sprinkler orifice. Provide a precast concrete splash block under each exterior discharge orifice.

2.1.13 Main Drains

Provide separate drain piping to discharge at safe points outside each building. The penetration of the exterior wall shall be no greater than 2.0 feet above finished grade. Provide auxiliary drains as required by NFPA 13. Provide precast concrete splash blocks under each exterior drain discharge.

2.1.14 Fire Department Connections

Provide 4 inches single Siamese type connections approximately 3 feet above finish grade, of the approved two-way type with 2.5 inch National standard female hose threads with brass caps, chain, and identifying fire department connection escutcheon plate.

2.2 BURIED WATER PIPING SYSTEMS

2.2.1 Pipe and Fittings

Provide outside-coated, cement-mortar lined, ductile-iron pipe, and fittings conforming to NFPA 24 for piping under the building and outside of building walls. Anchor joints in accordance with NFPA 24. Provide concrete thrust block at the elbow where the pipe turns up toward the floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. Minimum pipe size shall be 6 inches. Minimum depth of cover shall be 3 feet at finish grade. Piping beyond 5 feet outside of building walls shall be provided under Section 02510, "Water Distribution."

2.2.2 Valves

Provide as required by NFPA 24. Gate valves shall conform to UL 262 and shall open by counterclockwise rotation.

2.2.3 Post Indicator Valves

Provide with operating nut located about 3 feet above finish grade. Gate valves for use with indicator post shall conform to UL 262. Indicator posts shall conform to UL 789. Provide each indicator post with one coat of primer and two coats of red enamel paint.

2.2.4 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.3 PIPE SLEEVES

Provide where piping passes entirely through walls, floors, and roofs. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs. Provide one inch minimum clearance between exterior of piping and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with UL listed fill, void, or cavity material.

- a. Sleeves in Masonry and Concrete Walls, Floors, and Roofs: Provide hot-dip galvanized steel, ductile-iron, or cast-iron sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are grouted smooth.
- b. Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs: Provide 26 gage galvanized steel sheet.

2.4 ESCUTCHEON PLATES

Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

PART 3 EXECUTION

3.1 INSTALLATION

Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA 13, except as modified herein. Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings. Keep the interior and ends of new piping and existing piping affected by Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position. Provide Teflon pipe thread paste on male threads.

3.1.1 Electrical Work

Provide electrical work associated with this section under Section 16402, "Interior Distribution System," except for control and fire alarm wiring. Provide fire alarm system under Section 13852, "Interior Fire Detection and Alarm System." Provide control wiring under this section in accordance with NFPA 70. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be used in dry locations not enclosed in concrete or where not subject to mechanical

damage.

3.1.1.2 Disinfection

Disinfect the new water piping and existing water piping affected by Contractor's operations up to the backflow prevention device in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million (ppm) of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 ppm, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit results prior to the new water piping being placed into service. Disinfection of systems supplied by nonpotable water is not required.

3.1.1.3 Connections to Existing Water Supply Systems

Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around the main piping; bolt valve to the branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, all without interruption of service. Notify the Contracting Officer in writing at least 30 days prior to connection date; receive approval before any service is interrupted. Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labor as required. Furnish the labor and the tapping or drilling machine for making the actual connections to existing systems. All piping shall be photographed prior to burying, covering, or concealing.

3.1.1.4 Buried Piping System

Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.1.5 Field Painting

Painting of sprinkler systems above suspended ceilings and in crawl spaces is not required. Clean, prime, and paint new sprinkler system piping, valves, hangers, accessories, and miscellaneous metal work as specified Section 09900, "Paints and Coatings". Clean surfaces prior to painting. Immediately after cleaning, prime metal surfaces with FS TT-P-664 or SSPC Paint 25 metal primer applied to a minimum dry film thickness of 1.5 mils. Exercise care to avoid painting sprinkler heads and operating devices. Upon completion of painting, remove materials which were used to protect sprinkler heads and operating devices which have been inadvertently painted and provide new clean sprinkler heads and operating devices of the proper type. Finish primed surfaces as follows:

3.1.1.5.1 Systems in Finished Areas

Finished areas are defined as areas where walls or ceilings are painted or are constructed of a prefinished material. Paint primed surfaces with two coats of paint to match adjacent surfaces, except paint valves and

operating accessories with two coats of gloss red enamel. Provide piping with 2 inch wide red bands spaced at maximum 20 feet intervals throughout the piping system. Bands shall be gloss red enamel or self-adhering plastic.

3.1.5.2 Systems in Unfinished Areas

Paint piping in valve rooms, and mechanical rooms, with FS TT-E-489 gloss red enamel applied to a minimum dry film thickness of 1.6 mils.

3.2 FIELD QUALITY CONTROL

Perform test to determine compliance with the specified requirements in the presence of the Contracting Officer. Test, inspect, and approve piping before covering or concealing.

3.2.1 Preliminary Tests

Hydrostatically test each system at 50 psig above normal system static pressure or 200 psig, whichever is greater, for a 2-hour period with no leakage or reduction in pressure. Flush piping with potable water and air test each system in accordance with NFPA 13. Piping above suspended ceilings shall be tested, inspected, and approved before installation of ceilings. Test the alarms and other devices. Test the water flow alarms by flowing water through the inspector's test connection. Water shall be delivered to the system test connection in not more than 60 seconds, starting at the normal air pressure on the system and at the time of a fully opened inspection test connection. When tests have been completed and corrections made, submit a signed and dated certificate, similar to that specified in NFPA 13.

3.2.2 Formal Tests and Inspections

Do not submit a request for formal test and inspection until the preliminary test and corrections are completed and approved. Submit a written request for formal inspection at least 30 days prior to inspection date. An experienced technician regularly employed by the system installer shall be present during the inspection. At this inspection, repeat any or all of the required tests as directed. Correct defects in work provided by the Contractor, and make additional tests until the systems comply with contract requirements. Furnish appliances, equipment, electricity, instruments, connecting devices, and personnel for the tests. The Government will furnish water for the tests. The Atlantic Division, Naval Facilities Engineering Command, Fire Protection Engineer, will witness formal tests and approve systems before they are accepted.

-- End of Section --

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS
08/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2 (1997) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117 (1997) Operating Salt Spray (Fog) Apparatus

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1998; Errata 1999) Motors and Generators

NEMA MG 10 (1994) Energy Management Guide for
Selection and Use of Fixed Frequency
Medium AC Squirrel-Cage Polyphase
Induction Motors

NEMA MG 11 (1977; R 1992) Energy Management Guide of
Selection and Use of Single-Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 15, "Mechanical" of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements,

manufacturers' catalogs, or brochures during the 2 year period.

1.3.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.3.6 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Section 16402, "Interior Distribution System." Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 16402, "Interior Distribution System."

1.6 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.7 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves,

expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.
- b. Temperatures Between 120 and 400 Degrees F: Metal surfaces

subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

- c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

SECTION 15080

MECHANICAL INSULATION

09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(1995) Mineral Fiber Preformed Pipe Insulation
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyurethane Thermal Insulation
ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM C 1126	(1996) Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM D 1784	(1995) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM E 84	(1997; Rev. A) Surface Burning Characteristics of Building Materials

1.2 SYSTEM DESCRIPTION

Provide new field-applied mechanical insulation for mechanical systems. Mechanical systems include heating, ventilating, and cooling equipment, ducts, and piping which is located within, on, under, and adjacent to buildings; and for plumbing systems. Obtain Contracting Officer's written approval of each system before applying field-applied insulation. Provide new asbestos-free insulation materials.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Piping insulation and jacket

Duct insulation and jacket

Equipment insulation and jacket

PART 2 PRODUCTS

2.1 PIPING INSULATION AND JACKET

2.1.1 Mineral Fiber Preformed Pipe Insulation

ASTM C 547. Provide piping insulation jacket.

2.1.2 Rigid Cellular Phenolic Preformed Pipe Insulation

ASTM C 1126. Provide piping insulation jacket.

2.1.3 Cellular Glass Performed Pipe Insulation

ASTM C 552. Provide piping insulation jacket.

2.1.4 Flexible Cellular Preformed Pipe Insulation

ASTM C 534. Piping insulation jacket is not required.

2.1.5 Piping Insulation Jacket

Provide manufacturer's standard fire-retardant vapor barrier jacket. Jacket shall be suitable for painting. Provide factory prefabricated one-piece PVC insulation covers and mineral fiber insulation inserts of the same thickness as piping insulation for fittings, valves, and flanges.

2.2 DUCT INSULATION AND JACKET

2.2.1 Blanket Mineral Fiber Duct Insulation

ASTM C 553. Provide duct insulation jacket.

2.2.2 Rigid Mineral Fiber Duct Insulation

ASTM C 612. Provide duct insulation jacket.

2.2.3 Duct Insulation Jacket

Provide manufacturer's standard fire-retardant vapor barrier jacket. Jacket shall be suitable for painting.

2.3 EQUIPMENT INSULATION AND JACKET

Provide insulation for HVAC equipment and hot domestic water storage tanks.

2.3.1 Mineral Fiber Block and Board Insulation

ASTM C 612, minimum density of 6 pcf.

2.3.2 Cellular Glass Block and Board Insulation

ASTM C 552, minimum density of 6 pcf.

2.3.3 Calcium Silicate Block and Board Insulation

ASTM C 533.

2.3.4 Polyurethane Block and Board Insulation

ASTM C 591.

2.3.5 Phenolic Block and Board Insulation

ASTM C 1126.

2.3.6 Equipment Insulation Jacket

Provide manufacturer's standard fire-retardant vapor barrier jacket. Provide equipment insulation with aluminum jacket or waterproof aluminum pigmented mastic as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION OF MECHANICAL INSULATION

Clean exterior of mechanical systems prior to the application of field-applied insulation. Install field-applied insulation in accordance with the manufacturer's recommendations and as specified herein. The completed installation shall have a fire hazard rating in accordance with ASTM E 84; flame-spread rating shall not exceed 25 and smoke developed rating shall not exceed 50 except as specified herein; smoke developed rating shall not exceed 150 for polyurethane insulations. Insulation shall be clean and dry when installed and prior to the application of jackets and coatings. Do not use short pieces of insulation materials where a full length section will fit. Provide insulation materials and jackets with

smooth and even surfaces, with jackets drawn tight, and smoothly secured on longitudinal laps and end laps. Insulate fittings and piping accessories with premolded, precut, or field fabricated insulation of the same material and thickness as the adjoining pipe insulation. Provide unions, flanges, and piping accessories with readily removable sections of insulation and jacket. Provide insulation continuous through pipe hangers, pipe supports, pipe sleeves, wall openings, and ceiling openings. Provide a complete moisture and vapor seal wherever insulation terminates against hangers, anchors, and other projections through insulation on cold surfaces; fill joints, breaks, punctures, and voids with vapor barrier compound and cover with vapor sealed material. Do not conceal equipment nameplates. Cover ends of exposed insulation with waterproof mastic.

3.2 PIPING INSULATION

3.2.1 Insulation for Water Piping

Provide mineral fiber preformed pipe insulation for hot and cold domestic water piping, and cold drain piping. Rigid cellular phenolic preformed pipe insulation having an insulating efficiency not less than that of the specified thickness of mineral fiber pipe insulation may be provided in lieu of mineral fiber pipe insulation.

3.2.1.1 Hot and Cold Domestic Water Piping

Provide piping sizes less than 3 inches with minimum of 1 inch thick mineral fiber pipe insulation.

3.2.1.2 Cold Drain Piping

Provide minimum of one inch thick mineral fiber pipe insulation.

3.2.2 Insulation for Refrigerant Suction Piping

Provide minimum of 0.75 inch thick flexible elastomeric cellular preformed pipe insulation. Seal joints with waterproof vapor barrier adhesive. Cover joints with 1.5 inch wide waterproof vapor barrier tape. Provide flexible elastomeric cellular insulation with two coats of white exterior acrylic emulsion paint.

3.2.3 Piping Insulation Covering

Provide piping insulation with piping insulation jacket.

3.3 DUCT INSULATION

Provide duct insulation and jacket on exterior of supply ducts, return ducts, outside air intake ducts, and plenums, including metal on back of diffusers and registers. Apply insulation with joints tightly butted. Space pins or anchors at maximum of 12 inch centers; secure insulation with washers and clips. Pins or anchors shall be metal electrically welded to duct surface or shall be metal attached to duct surface with waterproof adhesive especially designed for attachment to metal surfaces. Sagging of duct insulation will not be permitted. Insulation shall be tightly and

smoothly applied to the ducts. Secure insulation to metal ducts with a fire-resistant, waterproof bonding adhesive applied in 4 inch wide strips on 12 inch centers. Provide minimum thickness of 1.5 inches of rigid duct insulation in mechanical equipment rooms and where indicated. Provide minimum thickness of 2 inches of blanket duct insulation in other locations.

3.3.1 Blanket Duct Insulation

Secure to bottom of rectangular horizontal and sloping ducts more than 24 inches wide, in addition to adhesive, by impaling over pins or anchors.

3.3.2 Rigid Duct Insulation

Secure to duct by impaling over pins or anchors located not more than 3 inches from edge of insulation and spaced at maximum 12 inch centers.

3.3.3 Vapor Barrier

Fill joints, breaks, punctures, and voids with vapor barrier coating compound and cover with vapor barrier jacket. At joints, the vapor barrier jacket for insulation shall be covered with 4 inch wide pressure-sensitive vapor seal tape of material identical to jackets, or shall have 2 inch wide laps drawn tight and secured with vapor seal adhesive. The joints and openings where the facing is pierced or punctured by pins, staples, or other means shall be brush coated with 2 inch wide strips of vapor barrier coating compound.

3.4 FIELD INSPECTIONS

Visually inspect the insulation installation of all mechanical systems to ensure that materials conform to requirements specified herein.

-- End of Section --

SECTION 15211

LOW PRESSURE COMPRESSED AIR PIPING (NON-BREATHING AIR TYPE)
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.24 (1991; Errata 1991) Cast Copper Alloy Pipe
Flanges and Flanged Fittings Class 150,
300, 400, 600, 900, 1500, and 2500

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 520 (1990) Positive Displacement Refrigerant
Compressors, Compressor Units and
Condensing Units

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ANSI/ASME B1.20.1 (1983; R 1992) Pipe Threads, General
Purpose (Inch)

ANSI/ASME B16.3 (1998) Malleable Iron Threaded Fittings

ASME/ANSI B16.5 (1996) Pipe Flanges and Flanged Fittings

ASME/ANSI B16.9 (1993) Factory-Made Wrought Steel
Buttwelding Fittings

ASME B16.11 (1996) Forged Fittings, Socket-Welding and
Threaded

ASME/ANSI B16.22 (1995) Wrought Copper and Copper Alloy
Solder Joint Pressure Fittings

ASME/ANSI B16.26 (1988) Cast Copper Alloy Fittings for
Flared Copper Tubes

ASME/ANSI B16.34 (1996; Addenda 1998) Valves - Flanged,
Threaded, and Welding End

ASME/ANSI B16.39 (1998) Malleable Iron Threaded Pipe Unions
Classes 150, 250, and 300

ASME B31.1 (1998) Power Piping

ANSI/ASME B40.1	(1991; Special Notice 1992) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC SEC VIII D1	(1995; Addenda 1995 and 1996) Boiler and Pressure Vessel Code: Section VIII Pressure Vessels, Division 1
ASME BPVC SEC IX	(1995; Addenda 1995 and 1996) Boiler and Pressure Vessel Code: Section IX Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 193/A 193M	(1999; Rev A) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(1999) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM D 1330	(1985; R 1995) Rubber Sheet Gaskets

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1996) Structural Welding Code - Steel
ANSI/AWS Z49.1	(1994) Safety in Welding, Cutting and Allied Processes

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.219	Mechanical Power Transmission Apparatus
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COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1689	(Rev. B) Tape, Pressure-Sensitive Adhesive, (Plastic Film)
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FEDERAL SPECIFICATIONS (FS)

FS F-F-351	(Rev. D) Filters and Filter Elements, Fluid Pressure: Lubricating Oil, Bypass
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and Full Flow

FS WW-U-516	(Rev. B) Unions, Brass or Bronze, Threaded Pipe Connections and Solder-Joint Tube Connections
FS QQ-B-654	(Rev. A) Brazing Alloys, Silver
FS WW-T-696	(Rev. E) Traps, Steam and Air
FS WW-S-2739	Strainers, Sediment: Pipeline, Water, Air, Gas, Oil, or Steam
FS XX-C-2816	Compressor, Air, Reciprocating or Rotary, Electric Motor Driven, Stationary, 10 HP and Larger

MILITARY SPECIFICATIONS (MIL)

MIL-T-27730	(Rev. A) Tape, Antiseize, Polytetrafluoroethylene, with Dispenser
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-84	(1990) Valves - Socket Welding and Threaded Ends
MSS SP-89	(1991) Pipe Hangers and Supports - Fabrication and Installation Practices

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA MG 1	(1998; Errata 1999) Motors and Generators

NATIONAL FLUID POWER ASSOCIATION (NFP(A))

NFP(A) T3.12.3 R2 (1992) Pressure Regulator - Industrial Type

PIPE FABRICATION INSTITUTE (PFI)

PFI ES-22 (1995) Color Coding of Piping Materials

PLUMBING AND PIPING INDUSTRY COUNCIL (PPIC)

PPIC GFSR (1982) Guidelines for Seismic Restraints
(GFSR) of Mechanical Systems and Plumbing
Piping Systems

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

SAE J 513 (1996) Refrigeration Tube Fittings

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 10 (1994) Near-White Blast Cleaning

1.2 RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods," applies to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Air Dryer

Pipe

Fittings

Valves

Pressure gages

Hangers and supports

Quick disconnect couplings

Filters

Strainers

Traps

Flexible connections

Dielectric unions

Hose reel assembly

Identification labels for piping

Tubing

SD-06 Test Reports

Hydrostatic tests

Leak tightness tests

SD-07 Certificates

Welding and brazing procedures

Welding procedure qualifications

Cleaning and flushing procedures

SD-10 Operation and Maintenance Data

Air dryer, Data Package 4

SD-11 Closeout Submittals

Posted operating instructions for air compressor

1.4 QUALITY ASSURANCE

Design, fabrication, installation, and testing of compressed air systems shall conform to ASME B31.1, ASME BPVC SEC VIII D1, and ASME BPVC SEC IX, except as specified otherwise. In ASME B31.1, ASME BPVC SEC VIII D1, and ASME BPVC SEC IX, the advisory provisions shall be considered mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" and "owner" shall be interpreted to mean the Contracting Officer.

1.4.1 Welding Procedure Qualifications

Provide all welding work specified in this section for compressed air piping systems in conformance with ASME B31.1, as modified and supplemented by this specification section. The welding work includes: qualification of welding procedures, brazing procedures, welders, brazers, welding operators, brazing operators, inspection personnel, and nondestructive examination personnel; maintenance of welding records, and examination methods for welds.

1.4.1.1 Butt Welded Joints

Butt welded joints shall be full penetration joints.

1.5 SAFETY PRECAUTIONS

1.5.1 Temperature Restriction

Compressors or other equipment shall not discharge compressed air to the piping systems above 100 degrees F unless approved by the Contracting Officer. Aftercoolers or other devices shall be provided to comply with the temperature restriction.

1.5.2 Rotating Equipment

Fully guard couplings, motor shafts, gears and other exposed rotating or rapidly moving parts in accordance with OSHA 29 CFR 1910.219. Provide rigid and suitably secured guard parts readily removable without disassembling guarded unit.

1.5.3 Welding and Brazing

Safety in welding, cutting, and brazing of pipe shall conform to ANSI/AWS Z49.1.

PART 2 PRODUCTS

2.1 LOW PRESSURE AIR COMPRESSOR UNIT, LESS THAN 10 HP

This equipment will be furnished by the Government installed by Contractor as GFCI (Government Furnished Contractor Installed Equipment).

2.2 LOW PRESSURE COMPRESSED AIR DRYERS

Provide low pressure compressed air dryers of the mechanical refrigeration type, equipped with an automatic temperature shutdown switch to prevent freezing, a regenerative air to air exchanger (in capacity sizes above 10 or 60 scfm as standard with the manufacturer), and a main compressed air cooling exchanger. Refrigeration system shall cool compressed air to dry the air. Dryer shall have no internal traps or filters and shall have pressure drop not greater than 3 psi. Air shall leave the dryer at a temperature of 100 degrees F and dew point of 50 degrees F, based on an inlet temperature of 100 degrees F. Provide internal tubing, wiring, and piping complete, such that only connections to air inlet and outlet, to refrigerant compressor contactor, and to condensate drain are necessary.

2.2.1 Air Circuit

- a. Regenerative Heat Exchanger: Inlet compressed air to outlet compressed air heat exchanger (in capacity sizes above 10 or 60 scfm as standard with the manufacturer) designed to reduce cooling load at design conditions 20 degrees F by inlet air precooling.
- b. Main Heat Exchanger: Single-pass, with air in the tubes, heat sink, direct expansion, or flooded cooler type.
- c. Separator: Fabricated in accordance with ASME B31.1; code stamp not required; moisture separator low velocity type incorporating

change of air flow direction to prevent moisture carryover.

- d. Dryer Operating Pressure: 125 psig working pressure.
- e. Drain Line: Provide with exterior mounted condensate trap to facilitate servicing.

2.2.2 Refrigeration System

- a. Refrigeration Compressor: ARI 520. Hermetic, semi-hermetic, or open reciprocating type equipped with automatic start-stop or unloading capacity control; standard components include inherent motor protection, crankcase oil strainer, and suction screen. Refrigerant shall be R-22.
- b. Dryer Controls: Capable of automatic 0 to 100 percent capacity control. Refrigeration controls shall maintain pressure dew point within the specified range without freezing of condensate. Controls shall include such devices as capillary tube, expansion valve, suction pressure regulator, thermostat, or other approved devices as standard with the manufacturer. Dryer shall have automatic shutdown switch sensor located at point of lowest temperature to prevent freezing.
- c. Refrigerant dryer and suction line strainer.
- d. Air-cooled condenser, with condenser fan and motor.

2.2.3 Instrumentation and Control

Include control panel in dryer cabinet containing:

- a. Indicators for the Following Services: Inlet air pressure gage, discharge air pressure gage, inlet air temperature gage, main exchanger temperature gage, refrigeration compressor suction pressure gage, refrigeration compressor discharge pressure gage, green "Power On" light, power interruption light, and high temperature light.
- b. Electrical Relays: Locate in an enclosed portion of the panel, accessible for ease of servicing.
- c. Controls and Interlocks: To maintain required compressed air dew point and to cycle air-cooled condenser with refrigeration compressor while maintaining head pressure control with low ambient temperature

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2.3 LOW PRESSURE COMPRESSED AIR PIPING AND ACCESSORIES

Low pressure compressed air piping and accessories 125 psig at 150 degrees F, shall conform to the following:

2.3.1 Steel Piping

- a. Pipe: ASTM A 53, seamless carbon steel, Schedule 40, black.
- b. Fittings, size 2 inches and larger: ASME/ANSI B16.9, carbon steel, butt welding, schedule 40, or ASME/ANSI B16.5, carbon steel welding neck flanges, Class 150, ASME/ANSI B16.5, flanged fittings, carbon steel, Class 150, gaskets 1/16 inch oil resistant synthetic rubber ASTM D 1330, bolts ASTM A 193/A 193M, Grade B7, and nuts, ASTM A 194/A 194M, Grade 7. Butt welded joints shall be full penetration consumable insert or backing ring type.
- c. Fittings, size 1 1/2 inches and smaller: ANSI/ASME B16.3, threaded malleable iron, Class 150, or ASME B16.11, forged carbon steel Class 3000 socket welding or Class 2000 threaded. Joints may also be butt welded or flanged, as specified for sizes 2 inches and larger.
- d. Flat-faced steel flanges: Where connections are made to Class 125 cast iron flanges with steel flanges, use only flat-faced Class 150 steel flanges.
- e. Unions: ASME/ANSI B16.39, Class 1 (300 psig WOG).

2.3.2 Copper Tubing

- a. Tubing: ASTM B 88, Type K or L, hard drawn, Class 1.
- b. Fittings: ASME/ANSI B16.22 wrought copper or bronze, with silver brazed joints.
- c. Brazing filler metal: FS QQ-B-654, Class III.
- d. Unions: bronze, FS WW-U-516, brazed joint type.
- e. Flanges and flanged fittings: ANSI B16.24, bronze, Class 150, gaskets, oil resistant synthetic rubber, ASTM D 1330, bolts ASTM A 193/A 193M, Grade B7, and nuts ASTM A 194/A 194M, Grade 7.
- f. Flared fittings: ASTM B 88, Type K or L, annealed, with ASME/ANSI B16.26 or SAE J 513 flared fittings.

2.3.3 Valves

2.3.3.1 Gate Valves

- a. Bronze Gate Valves: MSS SP-80, Class 150, 2 inches and smaller, wedge disc, rising stem, inside screw type, with brazed joints ends when used with copper tubing.
- b. Steel Gate Valves: MSS SP-84, 2 inches and smaller, ASME/ANSI B16.34, over 2 inches, flanged ends, outside screw and yoke type with solid wedge or flexible wedge disc, Class 150.

2.3.3.2 Globe and Angle Valves

- a. Bronze globe and angle valves: MSS SP-80, Class 150, 2 inches and smaller, Class 200, except that Class 150 valves with brazed ends may be used for copper tubing. Valves shall have renewable seats and discs except brazed-end valves which shall have integral seats.
- b. Steel globe and angle valves: MSS SP-84, 2 inches and smaller, ASME/ANSI B16.34, over 2 inches, flanged ends, Class 150.

2.3.3.3 Pressure Reducing Valves

NFP(A) T3.12.3 R2, with nominal pressure rating of not less than inlet system pressure indicated. Provide pressure reducing valves capable of being adjusted to specified flow and pressure, and suitable for intended service. Provide pilot valve for dome loaded type if required for proper operation.

2.3.3.4 Safety Valves

ASME BPVC SEC VIII D1 and ASME BPVC SEC IX Code stamped safety valve), 125 psig, for unfired pressure vessels, bronze, with threaded or flanged connections; factory set and sealed.

2.3.3.5 Check Valves

MSS SP-80, Bronze body with brazed joint or threaded ends or steel body with flanged end, ASME/ANSI B16.34, or threaded ends, MSS SP-84. The check valve shall have a perforated piston with closed downstream end, in line with the pipe and held closed by a steel poppet return spring.

2.3.3.6 Pressure Regulators

Diaphragm type, air loaded, tight closing single seat, brass body with integral filter and bowl. Pressure regulators used to deliver compressed air for cleaning shall be factory set at not more than 30 psig and shall be nonadjustable.

2.3.3.7 Needle Valves

One-piece bodies with integral or screwed bonnet, stems of hardened stainless steel with fine thread for metering and ease of adjusting, teflon packing; and shall be of the pressure balanced type. Needle valves shall be of the slow opening type.

2.3.4 Pressure Gages

ANSI/ASME B40.1, Accuracy Grade A, for air, with steel or brass case, and nonshatterable safety glass, and a pressure blowout back to prevent glass from flying out in case of an explosion. Gages shall have a 3 1/2 inch minimum diameter dial and a dial range of approximately twice working pressure.

2.3.5 Hangers and Supports

Provide pipe hangers and supports conforming to MSS SP-58, MSS SP-69, and ASME B31.1, except as specified or indicated otherwise. Furnish zinc plated pipe hangers and supports except for copper plated inserts for copper piping. Provide tubing supports of U-shaped steel bolts and nuts firmly secured to adequately support structures such as walls, columns, floors, or brackets. Clips shall fit closely around piping but shall have sufficient clearance to permit longitudinal movement of piping during normal expansion and contraction. Provide supports at valves, fittings, branch lines, outlets, changes in direction, equipment, and accessories.

2.3.6 Quick Disconnect Couplings

All brass and suitable for a working pressure of not less than 125 psig. Female side of coupling (fixed end) shall have male thread connection with automatic shutoff. Provide male side of coupling with hose stem and ball check to bleed pressure from hose and prevent hose whipping.

2.3.7 Single Cartridge Type Filters

125 psig operating pressure and filter housing of brass or bronze. Provide cellulose cartridge filters of graded density construction capable of removing liquids and solids of 5 microns and larger. Filter capacity shall be compatible with rated flow of equipment or pressure reducing valves provided.

2.3.8 Strainers

FS WW-S-2739. Bronze or malleable iron body, Class 125, Style Y, Type II, simplex type, with 20-mesh Monel or stainless steel screen.

2.3.9 Traps

FS WW-T-696 to drain water and other liquids from system. Type of traps, as indicated, and rated working pressure not less than system operating pressure.

2.3.10 Flexible Connections

Vibration isolation, wire braid reinforced corrugated metal hose type, line-sized, with bronze end connections, suitable for pressure indicated. Length as recommended by manufacturer but not less than 18 inches.

2.3.11 Dielectric Unions

Steel female pipe thread end and copper solder-joint ends, conforming to dimensional, strength and pressure requirements of ASME/ANSI B16.39, Class 1. Steel parts shall be galvanized or plated. Union shall have a water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint. When dry, it shall also be able to withstand a 600-volt breakdown test.

2.3.12 Tetrafluoroethylene Tape

MIL-T-27730 for screw-jointed pipe.

2.3.13 Hose Reel Assembly

Complete with 50 foot hose rated for a minimum of 125 psig, ball stop, hose extension with air coupler, hose rollers, reel enclosure, and required accessories.

2.4 SLEEVES

2.4.1 Floor Slabs, Roof Slabs, and Outside Walls Above and Below Grade

Galvanized-steel pipe having an inside diameter at least 1/2 inch larger than the outside diameter of the pipe passing through it. Provide sufficient sleeve length to extend completely through floors, roofs, and walls, so that sleeve ends are flush with finished surfaces except that ends of sleeves for floor slabs shall extend 1/2 inch above finished floor surface. Sleeves located in waterproofed construction shall include flange and clamping ring.

2.4.2 Partitions

Galvanized sheet steel, 26 gage or heavier, of sufficient length to completely extend through partition thickness with sleeve ends flush with partition finished surface.

2.5 IDENTIFICATION LABELS FOR PIPING

Labels for pipes 3/4 inch o.d. and larger shall bear printed legends to identify contents of pipes and arrows to show direction of flow. Except that of pipes smaller than 3/4 inch o.d., labels shall have color coded backgrounds to signify levels of hazard in accordance with PFI ES-22. Legends and type and size or characters shall also conform to PFI ES-22. Labels shall be made of plastic sheet in conformance with CID A-A-1689 with pressure-sensitive adhesive suitable for the intended applications or they may be premolded of plastic to fit over specific pipe outside diameters 3/4 inch and larger. For pipes smaller than 3/4 inch o.d., furnish brass identification tags 1 1/2 inches in diameter with legends in depressed black-filled characters.

2.6 FRESH WATER

Fresh water for cleaning, flushing, and testing shall be clean and potable.

2.7 SOURCE QUALITY CONTROL

Provide operational test to verify system is working prior to disconnecting GFE equipment. Existing equipment is located in basement at adjacent building 2106 approximately 1000 yards from Armory site.

PART 3 EXECUTION

3.1 INSTALLATION

Install materials and equipment as indicated and in accordance with the manufacturer's recommendations.

3.1.1 Piping

Unless specifically stated to the contrary, fabrication, assembly, welding, and brazing shall conform to ASME B31.1 for all piping of the air system. Piping shall follow the general arrangement shown. Cut piping accurately to measurements established for the work. Work piping into place without springing or forcing, except where cold-springing is specified. Piping and equipment within buildings shall be entirely out of the way of lighting fixtures and doors, windows, and other openings. Locate overhead piping in buildings in the most inconspicuous positions. Do not bury or conceal piping until it has been inspected, tested, and approved. Where pipe passes through building structure, pipe joints shall not be concealed, but shall be located where they may be readily inspected and building structure shall not be weakened. Avoid interference with other piping, conduit, or equipment. Except where specifically shown otherwise, vertical piping shall run plumb and straight and parallel to walls. Piping connected to equipment shall be installed to provide flexibility for vibration. Adequately support and anchor piping so that strain from weight of piping is not imposed on the equipment.

3.1.1.1 Fittings

Use long radius ells where appropriate to reduce pressure drops. Pipe bends in lieu of fittings may be used for low pressure piping where space permits. Pipe bends shall have a uniform radius of at least five times the pipe diameter and must be free from any appreciable flattening, wrinkling, or thinning of the pipe. Mitering of pipe to form elbows, notching straight runs to form full sized tees, or any similar construction shall not be used. Make branch connections with welding tees, except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ASME B31.1 may be used.

3.1.1.2 Clearances for Welding

Provide clearances from walls, ceilings, and floors to permit the installation of joints. The clearances shall be at least 6 inches for pipe sizes 4 inches and less, and sufficient in corners. However, the specified clearances shall not waive requirements for welders to be qualified for the positions to be welded.

3.1.1.3 Cleaning and Flushing Procedures

Before jointing and erection of piping or tubing, thoroughly clean interiors of pipe sections, tube, and components. In steel pipe, loosen scale and other foreign matter by rapping sharply and expel by wire brush and swab. Blow out both steel pipe and copper tube and components with compressed air at 100 psig or more. Maintain cleanliness by closure of pipe/tube openings with caps or plugs. Before making final terminal connections, blow out complete system with compressed air at 100 psig or more.

3.1.1.4 Changes in Pipe Size

Use reducing fittings for changes in pipe size. The use of bushings will not be permitted.

3.1.1.5 Drainage and Flexibility

Compressed air piping shall be free of unnecessary pockets and pitched approximately 3 inches per 100 feet in the direction of flow to low points.

Where pipes must be sloped so that condensate flows in opposite direction to air flow, slope 6 inches per 100 feet or greater. Provide flexibility by use of fittings, loops, and offsets in piping. Install branches at top of a main to prevent carryover of condensate and foreign matter.

3.1.2 Threaded Joints

Where possible use pipe with factory cut threads, otherwise cut pipe ends square, remove fins and burrs, and cut taper pipe threads in accordance with ANSI/ASME B1.20.1. Threads shall be smooth, clean, and full cut. Apply thread tape to male threads only. Work piping into place without springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Engage threads so that not more than three threads remain exposed.

3.1.3 Welding and Brazing Procedures

Perform welding and brazing in accordance with qualified procedures using qualified welders and welding operators and brazers. Do not perform welding and brazing when the quality of the completed weld or braze could be impaired by the prevailing working or weather conditions. The Contracting Officer will determine when weather or working conditions are unsuitable for welding. Welding of hangers, supports, and plates to structural members shall be in accordance with AWS D1.1.

3.1.3.1 Cleaning for Welding and Brazing

Surfaces to be welded or brazed shall be free from loose scale, slag, rust, paint, oil, and other foreign material. Joint surfaces shall be smooth and free from defects which might affect proper welding. Clean each layer of weld metal thoroughly by wire brushing, grinding, or chipping prior to inspection or deposition of additional weld metal.

3.1.3.2 Stress Cracking During Brazing

For material susceptible to stress corrosion cracking from molten brazing filler metal, avoid applying stress during brazing.

3.1.3.3 Welding or Brazing of Valves

Welding or Brazing of Valves: Disassemble valves subject to damage from heat during welding or brazing and reassemble after installation. Open valves two or three turns off the seat when not subject to heat damage during welding or brazing; do not backseat valve.

3.1.4 Flare Fittings

Provide flare fittings only where necessary to connect copper tubing to equipment. Use short sections of annealed tubing soldered or brazed to hard drawn tubing using couplings on expanded ends on the annealed tubing made with special tools designed for that purpose. Make flares with the appropriate flaring tools. Cut annealed tubing only with cutting wheel tool. Do not ream out inside burr or lip left by the cutting wheel but fold back lip with flare tool to form seal/gasket inside flare. When new, the flare should cover not more than 75 percent of the flare seating surface of either the male or female flare fittings. Put the flare nut on the tube before making the flare.

3.1.5 Valves

ASME B31.1. Install valves at the locations indicated and elsewhere as required for the proper functioning of the system.

3.1.5.1 Gate Valves

Provide gate valves unless otherwise directed. Install valves in positions accessible for operation and repair. Install valve with stem horizontal or above.

3.1.5.2 Globe Valves

Install globe valves so that the pressure will be below the disk. Install globe valves with the stems vertical.

3.1.5.3 Pressure-Reducing Valves

Provide compressed air entering each pressure-reducing valve with a strainer. Provide each pressure-reducing valve unit with two block valves and with a globe or angle bypass valve and bypass pipe. Provide a bypass around a reducing valve of reduced size to restrict its capacity to approximately that of the reducing valve. Provide each pressure reducing valve unit with an indicating gage to show the reduced pressure, and a safety valve on the low pressure side. These requirements do not apply to small pressure regulating valves used to adjust pressure for pneumatic equipment.

3.1.6 Hangers and Supports

Selection, fabrication and installation of piping hangers and supports shall conform to MSS SP-58, MSS SP-69, and MSS SP-89.

3.1.7 Pressure Gages

Provide pressure gages with a shut-off valve or petcock installed between the gage and the line.

3.1.8 Strainers

Provide strainers with meshes suitable for the services where indicated, or where dirt might interfere with the proper operation of valve parts, orifices, or moving parts of equipment.

3.1.9 Equipment Foundations

Provide equipment foundations of sufficient size and weight and of proper design to preclude shifting of equipment under operating conditions or under any abnormal conditions which could be imposed upon the equipment. Provide foundations which meet the requirements of the equipment manufacturer, and when required by the Contracting Officer, obtain from the equipment manufacturer approval of the foundation design and construction for the equipment involved. Equipment vibration shall be maintained within acceptable limits, and shall be suitably dampened and isolated.

3.1.10 Equipment Installation

Install equipment strictly in accordance with these specifications, and the manufacturers' installation instructions. Grout equipment mounted on concrete foundations before piping is installed. Install piping in a manner that does not place a strain on any of the equipment. Do not bolt flanged joints tight unless they match properly. Extend expansion bends adequately before installation. Grade, anchor, guide and support piping without low pockets.

3.1.11 Cleaning of System

Clean the various system components before final closing as the installations are completed. Remove foreign matter from equipment and surrounding areas. Preliminary or final tests will not be permitted until the cleaning is approved by the Contracting Officer.

3.1.12 Pipe Sleeves

Provide pipe sleeves where pipes and tubing pass through masonry or concrete walls, floors, roofs, and partitions. Hold sleeves securely in proper position and location before and during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, or slabs. Extend sleeves in floor slabs 2 inches above the finished floor. Pack space between the pipe or tubing and the sleeve firmly with oakum and caulk both ends of the sleeve with elastic cement.

3.1.13 Floor, Wall, and Ceiling Plates

Provide chromium-plated steel or nickel-plated cast iron plates on pipes passing through floors and partitions of finished rooms. Provide painted cast-iron, malleable iron, or steel for other areas.

3.1.14 Flashing for Buildings

Provide flashing as required in accordance with Section 07600, "Flashing and Sheet Metal" where pipes pass through building roofs and outside walls.

3.1.15 Unions and Flanges

Provide unions and flanges where necessary to permit easy disconnection of piping and apparatus, and as indicated. Provide a union for each connection having a screwed-end valve. Provide unions on piping under 2 inches in diameter. Install dielectric unions or flanges between ferrous and non-ferrous piping, equipment, and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous-to-ferrous or non-ferrous to non-ferrous connections.

3.1.16 Painting of Piping and Equipment

Paint piping and equipment in accordance with Section 09900, "Paints and Coatings."

3.1.17 Identification of Piping

Identify piping in accordance with PFI ES-22. Use commercially manufactured piping identification labels. Space identification marking on runs not farther apart than 50 feet. Provide two copies of the piping identification code framed under glass and install where directed.

3.2 CLEANING SILVERBRAZED PIPING

Clean silverbrazed piping to remove residual flux remaining in the system after fabrication. Use one of the procedures below. The hot flush and hot recirculating flush are preferred. Minimum flow rate through any part of the system in gallons per minute shall be 1.5 times the inside diameter of the pipe in inches. For any flushing method used, the system shall be full of water so that joints are completely submerged at all times.

3.2.1 Hot Flushing Method

Hot flush the system for one hour using heated fresh water. No part of the system shall go below 110 degrees F.

3.2.2 Hot Recirculating Flush Method

Perform hot recirculating flush for one hour. Heat water during flushing so that no part of the system falls below 110 degrees F. After completing the hot recirculating flush, flush the system with cold fresh water for 15 minutes.

3.2.3 Cold Soak Method

Cold soak the system using fresh water at not less than 60 degrees F for 12 hours. Following the 12 hour soak, flush the system with fresh water at not less than 60 degrees F for 4 hours.

3.3 FIELD QUALITY CONTROL

3.3.1 Examinations

3.3.1.1 Welding Examinations

The Contractor shall perform visual examinations to detect surface and internal discontinuities in completed welds. Visually examine all welds. When examination indicates defects in a weld joint, the weld shall be repaired by a qualified welder. Remove and replace defects as specified in ASME B31.1, unless otherwise specified. Repair defects discovered between weld passes before additional weld material is deposited. Whenever a defect is removed, and repair by welding is not required, blend the affected area into the surrounding surface, eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, examine the area by the same methods which first revealed the defect to ensure that the defect has been eliminated. After rewelding, reexamine the repaired area by the same test methods originally used for that area. Any indication of a defect shall be regarded as a defect unless reevaluation by surface conditioning and reexamination shows that no unacceptable defects are present. The use of any foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

3.3.1.2 Brazing Examinations

The Contractor shall perform brazing examinations. Visually examine all compressed air systems as follows:

- a. Check brazed joint fit-up. Diametrical clearances shall conform to brazing procedure requirements.
- b. Check base material of pipe and fitting for conformance to the applicable drawing or specification.
- c. Check grade of brazing alloy for conformance to the brazing procedure before fit-up or brazing.
- d. Check completed brazed joint for a complete ring of brazing alloy between the outside surface of the pipe and the face of the fitting, and for a visible fillet.
- e. Check stainless steel and other susceptible material for evidence of stress cracks. Check inside of joint if possible with borescope or other aids.

Defective joints may be repaired. However, no more than two attempts to repair by reheating and additional face feeding of brazing filler metal will be permitted, after which the defective joint shall be unsweated, reprepared as a new joint, examined for defects on pipe and fittings, and rebrazed.

3.3.2 Testing

3.3.2.1 General Requirements, Testing

Perform testing after cleaning. Contractor shall provide everything required for tests. Tests shall be subject to the approval of the Contracting Officer. Calibrate the test pressure gages with a dead weight tester within 15 days before use and certify by initial and date on a sticker applied to dial face. Pressurize each piping system individually

and check to assure that there are no cross-connections between different systems prior to hydrostatic and operational tests.

3.3.2.2 Hydrostatic Tests and Leak Tightness Tests

a. Preliminary Preparation

Remove or isolate from the system the compressor, air dryer, filters, instruments, and equipment which would be damaged by water during hydrostatic tests and reinstall after successful completion of tests.

b. Performance of Hydrostatic Tests

Hydrostatically test piping systems in accordance with ASME B31.1. Vent or flush air from the piping system. Pressurize system for 10 minutes with water at one and one-half times design working pressure, then reduce to design working pressure and check for leaks and weeps.

c. Compressed Air Leak Test

After satisfactory completion of hydrostatic pressure test, blow systems dry with clean, oil-free compressed air, and test with clean, dry air at design working pressure. Brush joints with soapy water solution to check for leaks. Install a calibrated test pressure gage in piping system to observe any loss in pressure. Maintain required test pressure for a sufficient length of time to enable an inspection of joints and connections.

3.3.2.3 Operational Tests

Test equipment as in service to determine compliance with contract requirements and warranty. During the tests, test equipment under every condition of operation. Test safety controls to demonstrate performance of their required function. Completely test system for compliance with specifications.

-- End of Section --

SECTION 15400

PLUMBING SYSTEMS

09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A40	(1993) Safety Requirements for Plumbing
ANSI A112.21.2M	(1983) Roof Drains
ANSI A112.36.2M	(1991) Cleanouts
ANSI B16.18	(1984; R 1994, 1996) Cast Copper Alloy Solder Joint Pressure Fittings
ANSI Z21.10.1	(1993; Addenda 1994) Gas Water Heaters Volume I Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less
ANSI Z21.22	(1999) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems
ANSI Z124.1	(1987; Addenda 1990) Plastic Bathtub Units
ANSI Z124.2	(1987; Addenda 1990) Plastic Shower Receptors and Shower Stalls
ANSI Z124.8	(1990) Plastic Bathtub Liners
ANSI Z358.1	(1990) Emergency Eyewash and Shower Equipment

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 1010	(1994) Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers
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AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.6.1M	(1997) Supports for the Off-the-Floor Plumbing Fixtures for Public Use
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ASME A112.18.1M	(1996) Plumbing Fixture Fittings
ASME A112.19.1M	(1994; Errata 1996) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	(1995; Errata 1995) Vitreous China Plumbing Fixtures
ASME A112.19.3M	(1987; R 1996) Stainless Steel Plumbing Fixtures (Designed for Residential Use)
ASME A112.19.4M	(1994; Errata 1996) Porcelain Enameled Formed Steel Plumbing Fixtures
ASME A112.21.1M	(1991) Floor Drains
ANSI/ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME/ANSI B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1003	(1993; Errata 1993) Water Pressure Reducing Valves
ASSE 1014	(1989) Performance Requirements for Hand-Held Showers
ASSE 1019	(1993) Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 518M	(1992) Corrosion-Resistant High-Silicon Iron Castings (Metric)
ASTM A 518	(1992) Corrosion-Resistant High-Silicon Iron Castings
ASTM B 32	(1996) Solder Metal
ASTM B 42	(1998) Seamless Copper Pipe, Standard Sizes
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM B 88	(1999) Seamless Copper Water Tube

ASTM D 2665 (1997; Rev. A) Poly(Vinyl Chloride) (PVC)
Plastic Drain, Waste, and Vent Pipe and
Fittings

ASTM D 2846/D 2846M (1997) Chlorinated Poly(Vinyl Chloride)
(CPVC) Plastic Hot- and Cold-Water
Distribution Systems

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C651 (1992) Disinfecting Water Mains

AWWA C701 (1988) Cold-Water Meters - Turbine Type,
for Customer Service

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301 (1995) Hubless Cast Iron Soil Pipe and
Fittings for Sanitary and Storm Drain,
Waste, and Vent Piping Applications

CISPI 310 (1995) Couplings Joint for Use in
Connection with Hubless Cast Iron Soil
Pipe and Fitting

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULICRESEARCH
(FCCCHR)

FCCCHR-USC List of Approved Backflow Prevention
Assemblies

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC (1997; Supp. 1998) International Plumbing
Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND
FITTINGSINDUSTRY, INC. (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports -
Materials, Design and Manufacture

MSS SP-69 (1996) Pipe Hangers and Supports -
Selection and Application

MSS SP-70 (1998) Cast Iron Gate Valves, Flanged and
Threaded Ends

MSS SP-71 (1997) Cast Iron Swing Check Valves,
Flanged and Threaded Ends

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check
Valves

MSS SP-85 (1994) Cast Iron Globe and Angle Valves
Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (1996) National Fuel Gas Code

NFPA 211 (1996) Chimneys, Fireplaces, Vents, and
Solid Fuel Burning Appliances

UNDERWRITERS LABORATORIES INC. (UL)

UL 174 (1996) Household Electric Storage Tank
Water Heaters

UL 250 (1993; R 1994, Bul. 1996; R 1997)
Household Refrigerators and Freezers

UL 430 (1994; R 1996, Bul. 1996) Waste Disposers

UL 499 (1997) Electric Heating Appliances

UL 749 (1997) Household Dishwashers

1.2 SYSTEM DESCRIPTION

Provide plumbing systems, complete and ready for operation. Plumbing systems including plumbing fixtures, equipment, and piping which is located within, on, under, and adjacent to buildings, shall be in accordance with the required and advisory provisions of the Plumbing Code (ICC IPC). Plumbing systems include piping less than 5 feet outside of building walls.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Flush valve water closets

Wall hung lavatories

Countertop sinks

Water heaters; G

Shower faucets

SD-10 Operation and Maintenance Data

Water heaters, Data Package 2

Submit in accordance with Section 01781, "Operation and

Maintenance Data."

PART 2 PRODUCTS

2.1 PLUMBING FIXTURES

2.1.1 Flush Valve Water Closets

ASME A112.19.2M, white vitreous china, siphon jet, elongated bowl, floor-mounted, floor outlet. Top of toilet seat height above floor shall be 14 to 15 inches. Provide wax bowl ring including plastic sleeve. Water flushing volume of the water closet and flush valve combination shall not exceed 1.6 gallons per flush. Provide white solid plastic elongated open-front seat. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Mount flush valves not less than 11 inches above the fixture.

2.1.2 Wall Hung Lavatories

ASME A112.19.2M, white vitreous china, straight back type, minimum dimensions of 19 inches, wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top mounted washerless centerset faucets.

2.1.3 Countertop Sinks

ASME A112.19.3M, 20 gage stainless steel with integral mounting rim for flush installation, minimum dimensions of 33 inches wide by 21 inches front to rear, two compartments, with undersides fully sound deadened, with supply openings for use with top mounted washerless sink faucets with hose spray, and with 3.5 inch drain outlet. Provide stainless steel drain outlets and stainless steel cup strainers. Provide top mounted washerless sink faucets with hose spray.

2.1.4 Precast Terrazzo Shower Floors

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

2.2 FIXTURE FAUCETS AND ACCESSORIES

ASME A112.18.1M for plumbing fixture faucets. The finish of plumbing fixture faucets and accessories exposed to view shall be chromium-plated or polished stainless steel except as modified herein. Handles may be clear plastic. Bolts, nuts, and screws shall be copper alloy or stainless steel. Provide globe valves or angle valves, and union connections in each supply

to each faucet; chromium-plated finish is not required. Faucets shall be washerless type and shall have threaded type end connections, coupling nuts, or union connections. Faucets may be of the single control type. Provide washers and locknuts to secure faucets to lavatories and sinks.

2.2.1 Lavatory Faucets

Provide washerless faucets including aerators. Faucet handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist; maximum force required to operate faucet handles shall be 5 pounds of force.

2.2.2 Lavatory Drain Outlets

Provide drain outlets and drain tail pieces for each lavatory. Provide perforated grid strainers for each lavatory.

2.2.3 Traps

Provide P-trap for each plumbing fixture which does not have integral trap. Provide 1.5 inch white PVC adjustable P-traps and tubing with slip nuts and gaskets; chromium-plated finish is not required.

2.2.4 Sink Faucets

Provide top mounted washerless faucets including swing spouts, aerators and hose spray.

2.2.5 Shower Faucets

Provide single control pressure equalizing shower faucets with body mounted from behind the wall with threaded connections. Provide ball joint self-cleaning shower heads. Provide tubing mounted from behind the wall between shower faucets and shower heads. Provide globe valves or angle valves with union connections in each supply to faucet.

2.3 EQUIPMENT

2.3.1 Water Heaters (Electric)

UL 174, electric water heaters with double heating element, glass-lined steel tanks, high efficiency type insulated with polyurethane foam insulation, replaceable anodes, with adjustable range thermostat to allow hot water settings between 110 and 160 degrees F. Provide ANSI Z21.22 combination pressure and temperature relief valve, copper alloy body, automatic reseating, test lever, and discharge capacity based on AGA temperature steam rating. Provide plastic lined threaded steel dielectric pipe nipple at the water inlet connection and at the water outlet connection.

2.4 DRAIN, WASTE, AND VENT (DWV) PIPE AND FITTINGS

Fittings shall be long radius fittings, except fittings in vent piping may be short radius fittings. Minimum size piping shall be 2 inches for buried

piping and 1.5 inches for aboveground piping.

2.4.1 Buried Piping

2.4.1.1 Polyvinyl Chloride (PVC) System

ASTM D 2665, plastic pipe, fittings, and solvent cement.

2.4.2 Aboveground Piping

2.4.2.1 Polyvinyl Chloride (PVC) System

ASTM D 2665, plastic pipe, fittings, and solvent cement.

2.4.3 Cleanouts

ANSI A112.36.2M; provide threaded PVC plastic cleanout plugs.

2.4.3.1 Floor Cleanouts

Provide cast-iron or ductile-iron floor cleanout with anchor flange, adjustable height polished bronze, stainless steel, or chromium-plated copper alloy rim and scoriated floor plate with "CO" cast in the plate, and countersunk screws for installing floor plate flush with finished floor.

2.4.3.2 Wall Cleanouts

Provide polished stainless steel or chromium-plated copper alloy cover plate and secure to cleanout plug with countersunk stainless steel screw.

2.4.4 Drains

ASME A112.21.1M; provide cast-iron or ductile-iron drains and clamping rings for use with membrane waterproofing. Provide P-traps for each floor drain.

2.4.4.1 Flush Strainer Floor Drains

Provide with double drainage flange, perforated or slotted cast bronze, polished stainless steel, or chromium-plated copper alloy strainer, and adjustable collar. Drains of sizes 2, 3, and 4 inches shall have strainers with minimum free drainage area of 5, 11, and 18 square inches, respectively.

2.4.4.2 Shower Floor Drains

Provide as specified for flush strainer floor drains, except that finish shall be polished stainless steel or chromium-plated copper alloy. PVC drains may be provided for plastic shower stalls.

2.5 DOMESTIC WATER PIPING

2.5.1 Soldered Joint Copper Tubing

Provide ASTM B 88, Type L or M for aboveground piping, Type K for buried piping, with ANSI B16.18 or ASME/ANSI B16.22 solder joint fittings, unions, and flanges; provide adapters as required. Provide ASTM B 42 copper pipe nipples with threaded end connections. Provide ASTM B 32, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder.

2.5.2 Water Valves

Provide valves suitable for minimum of 125 psig and minimum of 180 degrees F hot water. Valves shall have threaded end connections with a union on all but one side of the valve. Ball valves may be provided in lieu of gate valves. Provide blue finish and red finish on handwheels for valves in cold domestic water piping and hot domestic water piping, respectively.

2.5.2.1 Gate Valves

MSS SP-80, Class 125.

2.5.2.2 Check Valves

MSS SP-80, Class 125, swing check.

2.5.2.3 Ball Valves

Full port design, copper alloy. Valves shall have two-position lever handles.

2.5.2.4 Hose Bibbs

Provide angle type copper alloy hose bibb with removable handwheel. Inlet shall have internal threads. Outlet shall have vacuum breaker with 0.75 inch external hose threads.

2.5.2.5 Nonfreeze Wall Hydrant

ASSE 1019, with lockshield and removable handwheel. Inlet shall have internal threads. Outlet shall have automatic draining vacuum breaker with 0.75 inch external hose threads. Hydrant shall be of sufficient length to extend through walls and place the valve seat inside the building or in the crawl space. Bonnet and valve stem shall be removable from outside of the building.

2.6 MISCELLANEOUS PIPING ITEMS

2.6.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated or polished stainless steel finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces.

2.6.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, and floors.

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, and floors. Provide one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

2.6.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.6.3 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.6.4 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of plumbing systems including fixtures, equipment, materials, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the Plumbing Code, ANSI A40, and in accordance with the manufacturer's recommendations.

3.1.1 Threaded Connections

Jointing compound for pipe threads shall be Teflon pipe thread paste; apply only on male threads. Do not thread metal pipe into plastic piping.

3.1.2 Pipe Hangers (Supports)

Provide additional pipe hangers at the concentrated loads in piping, such as for inline water pumps and flanged valves.

3.1.2.1 Piping to Receive Insulation

Provide temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations. Temporary wood spacers shall be of the same thickness as the insulation to be provided under Section 15080, "Mechanical Insulation."

3.1.2.2 Maximum Spacing in Vertical Piping

Support metal piping at not more than 10 foot intervals, with pipe riser clamps or offset pipe clamps. Support plastic piping at not more than 5 foot intervals.

3.1.2.3 Maximum Spacing in Horizontal Piping

Support cast-iron piping at 5 foot intervals, except for pipe exceeding 5 foot length, provide hangers at intervals equal to the pipe length but not exceeding 10 feet. Support plastic piping at 4 foot intervals and at each change of direction. Support copper tubing as follows:

MAXIMUM SPACING (FEET)										
Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Copper Tube	6	7	8	8	9	10	11	12	13	14

3.1.3 Copper Tube Extracted Joint

An extracted mechanical tee joint may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to ensure a free flow joint. Braze extracted joints using a copper phosphorus classification brazing filler metal. Soldered joints shall not be permitted.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Testing

Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the following tests in addition to the tests specified in the Plumbing Code, except as modified herein. Correct defects in the work provided by the Contractor, and repeat tests until work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for performing tests.

3.2.1.1 Domestic Water Piping

Before applying insulation, hydrostatically test each piping system at not less than 120 psig with no leakage or reduction in gage pressure for 2

hours.

3.2.1.2 DWV Piping

Before the installation of fixtures, cap ends of each system, fill piping with water to the roof, and allow to stand until a thorough inspection has been made. If the system is tested in sections, each opening shall be plugged and each section tested with not less than a 10 foot head of water.

After plumbing fixtures have been set and their traps filled with water, subject the entire sanitary system to a final air pressure test of not more than 1.0 inch of water column and a smoke or peppermint test. Perform the air and smoke test with an approved smoke testing machine which shall show a clear passage of smoke and air throughout the entire system. The entire system shall be proven absolutely tight under such test.

3.2.2 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.3 DISINFECTION

Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service.

-- End of Section --

SECTION 15700

HEATING, VENTILATING, AND COOLING SYSTEM
08/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)

AHAM DCRAC (1994) Directory of Certified Room Air Conditioners

AHAM RAC-1 (1992) Room Air Conditioners

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

ANSI/AMCA 210 (1990) Testing Fans for Rating

AMCA 500 (1991) Louvers, Dampers and Shutters

AMCA 511 (1991) Certified Ratings Program for Air Control Devices

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.18 (1984; R 1994, 1996) Cast Copper Alloy Solder Joint Pressure Fittings

ANSI B16.23 (1992; Errata 1994) Cast Copper Alloy Solder Joint Drainage Fittings - DWV

ANSI Z21.22 (1999) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems

ANSI Z21.64 (1990; Addenda 1992) Direct Vent Central Furnaces

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI APD (1996) Applied Products Directory

ARI UD (1996) Unitary Directory

ARI 210/240 (1994) Unitary Air-Conditioning and Air-Source Heat Pump Equipment

ARI 310	(1990) Packaged Terminal Air-Conditioners
ARI 340/360	(1993) Commercial and Industrial Unitary Air Conditioning and Heat Pump Equipment
ARI 365	(1994) Commercial and Industrial Unitary Air-Conditioning Condensing Units
ARI 380	(1990) Packaged Terminal Heat Pumps
ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1989) Central-Station Air-Handling Units
ARI 440	(1998) Room Fan-Coil and Unit Ventilator
ARI 550/590	(1998; Addendum 1999) Water-Chilling Packages Using the Vapor Compression Cycle
ARI 710	(1986) Liquid-Line Driers
ARI 880	(1998) Air Terminals

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE 15	(1994; Errata 1994) Safety Code for Mechanical Refrigeration
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AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ANSI/ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME/ANSI B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME/ANSI B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME/ANSI B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME/ANSI B16.34	(1996; Addenda 1998) Valves - Flanged, Threaded, and Welding End
ASME/ANSI B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

ASME B31.1	(1998) Power Piping
ASME/ANSI B31.5	(1992; Addenda 1994) Refrigeration Piping
ASME BPVC	(1998) Boiler and Pressure Vessel Codes
AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)	
ASSE 1003	(1993; Errata 1993) Water Pressure Reducing Valves
AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)	
ASTM A 53/A 53M	(1999; Rev B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	(1999) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 193/A 193M	(1999; Rev A) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(1999) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 653/A 653M	(1999; Rev A) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 32	(1996) Solder Metal
ASTM B 42	(1998) Seamless Copper Pipe, Standard Sizes
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 280	(1999) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 306	(1999) Copper Drainage Tube (DWV)
ASTM C 1071	(1998) Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM D 4021	(1992) Glass-Fiber-Reinforced Polyester Underground Petroleum Storage Tanks

ASTM F 441/F 441M (1999) Chlorinated Poly (Vinyl Chloride)
(CPVC) Plastic Pipe Schedules 40 and 80

ETL TESTING LABORATORIES (ETL)

ETL DLP (2000) Directory of ETL Listed Products

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH
(FCCCHR)

FCCCHR-USC List of Approved Backflow Prevention
Assemblies

GAS APPLIANCE MANUFACTURERS ASSOCIATION (GAMA)

GAMA CDCER (1996) Consumer's Directory of Certified
Efficiency Ratings for Residential Heating
and Water Heating Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY, INC. (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports -
Materials, Design and Manufacture

MSS SP-67 (1995) Butterfly Valves

MSS SP-69 (1996) Pipe Hangers and Supports -
Selection and Application

MSS SP-70 (1998) Cast Iron Gate Valves, Flanged and
Threaded Ends

MSS SP-71 (1997) Cast Iron Swing Check Valves,
Flanged and Threaded Ends

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check
Valves

MSS SP-85 (1994) Cast Iron Globe and Angle Valves
Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1993) Industrial Control and Systems
Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31 (1997) Installation of Oil Burning
Equipment

NFPA 70 (1999) National Electrical Code

NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems
NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)	
NRCA RWM	(1996) Roofing and Waterproofing Manual
SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)	
SMACNA DCS	(1995; Addendum 1997) HVAC Duct Construction Standards - Metal and Flexible
SMACNA HVACADLTM	(1985) HVAC Air Duct Leakage Test Manual
UNDERWRITERS LABORATORIES INC. (UL)	
UL BMD	(1997) Building Materials Directory
UL EAUED	(1998) Electrical Appliance and Utilization Equipment Directory
UL 142	(1993) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 181	(1996; Bul. 1996) Factory-Made Air Ducts and Air Connectors
UL 296	(1994; R 1998) Oil Burners
UL 507	(1999) Electric Fans
UL 555	(1999) Fire Dampers
UL 726	(1995) Oil-Fired Boiler Assemblies
UL 1042	(1994; R 1998) Electric Baseboard Heating Equipment
UL 1316	(1994; R 1996) Glass-Fiber Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures

1.2 SYSTEM DESCRIPTION

Provide new heating, ventilating, and cooling (HVAC) systems complete and ready for operation. HVAC systems include equipment, ducts, and piping which is located within, on, under, and adjacent to buildings.

1.2.1 Installation Manual

Provide for each item of equipment.

1.3 DEFINITIONS

- a. Year 2000 (Y2K) compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Split-system heat pumps; G

Electric baseboard units

Exhaust fans; G

Diffusers, registers, and grilles; G

Charcoal filter rack and filter

SD-08 Manufacturer's Instructions

Installation manual

SD-10 Operation and Maintenance Data

Split-system heat pumps, Data Package 3

Electric baseboard units, Data Package 5

Exhaust fans, Data Package 2

Charcoal filter rack and filter

Submit in accordance with Section 01781, "Operation and Maintenance Data."

PART 2 PRODUCTS

2.1 Y2K COMPATIBILITY

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology.

This includes, but is not limited to, programmable thermostats, HVAC controllers, utility monitoring and control systems, alarms, and other

facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers.

2.2 EQUIPMENT

Equipment using refrigerants R-11, R-12, R-113, R-114, R-115, R-500, or refrigerants with ozone depletion factor (ODF) greater than 0.05 shall not be permitted.

2.2.1 Split-System Heat Pumps

Provide units factory assembled, designed, tested, and rated in accordance with ARI 210/240 or ARI 340/360. Units shall be ARI certified or rated in ARI UD in lieu of listing in the ARI Directory, a letter of certification from ARI that the units have been certified and will be listed in the next Directory will be acceptable. Outside unit shall include compressor and condenser. Units shall include casing, centrifugal fan and motor, primary VAV damper or valve, solid state speed controller or discharge air damper, primary air inlet cone with high and low pressure flow sensors, recirculating air filter frames, filter, and electrical disconnect.

- a. Filter section: Provide UL listed throwaway one one inch fiberglass filters, standard dust-holding capacity, 350 fpm maximum face velocity. Filter rack shall accept 2 inch thick filters.
- b. Safety controls: Provide low refrigerant pressure protection and pressure relief device. Provide compressor motor with thermal and overload protection, 5 minute anti-recycle timer, and start capacitor kit. Provide compressor with electrical crankcase heater and internal high pressure protection. The above safety controls are not required when scroll compressors are provided.
- c. Supplemental heater section: Provide UL or ETL listed electric resistance heaters including internal fusing integral with indoor unit; fan shall run until heater cools. Locate downstream of indoor coil. Provide controls to operate heater only when indoor unit is indexed in heating mode and outdoor readings indicate outside temperature is below 35 degrees F or unit balance point, whichever is higher; and when unit is in defrost mode at any outside temperature.
- d. Space temperature controls: Provide an indicator light on the room temperature sensor which shall indicate when supplementary heaters are operating. Provide controls under Section 15910, "Direct Digital Control Systems."
- e. Air Coils: Extended-surface fin and tube type with seamless copper or aluminum tubes with copper or aluminum fins securely bonded to the tubes. On coils with all-aluminum construction, provide tubes of aluminum alloy 1100, 1200, or 3102; provide fins of aluminum alloy 7072; and provide tube sheets of aluminum alloy 7072 or 5052.

- f. Compressors: Capacity reduction may be accomplished by cylinder unloading, use of multiple, but not more than four compressors, of a combination of the two methods. Units with cylinder unloading shall start with capacity reduction devices in the unloaded position. Units with multiple compressors shall have a means to sequence starting of compressors. Provide compressors with devices to prevent short cycling when shutdown by safety controls. Provide reciprocating compressors with crankcase heaters, and vibration isolators.

2.2.2 Electric Baseboard Units

UL 1042; wattage, voltage, phase, heat in Btu per hour output indicated. Provide units complete with heating elements, mounting brackets, end closures, splice plates, interior and exterior corners and accessible wiring compartment. Limit outlet air temperature and enclosure surfaces to 200 degrees F under continuous operating conditions.

2.2.2.1 Enclosure

Fabricate from steel or aluminum not less than 18 gage. Provide galvanized finish. Locate terminal blocks for branch circuit conductor and control wiring connections from the bottom rear right or left side as required. Wiring shall conform to NFPA 70.

2.2.2.2 Limit Control

Provide thermal overload and over voltage protection.

2.2.2.3 Disconnect Means

Provide factory-installed safety disconnect switch in combination with thermostat with "off" position marking on the face plate.

2.2.2.4 Unit Thermostat

Provide tamper resistant integral tool adjustable thermostat, without requiring removal of cabinet parts. Thermostat, operating range shall be approximately 50 degrees F to a maximum of 75 degrees F with operating differential of 3 degrees F or less.

2.2.3 Exhaust Fans

2.2.3.1 In-Line Centrifugal Fans

ANSI/AMCA 210 with AMCA seal. Provide welded steel casings, centrifugal backward inclined blades, direct drive. Inlet and outlet connections for fan casings to ductwork and equipment casings, may be of the slip fit or flanged type. Inlet shall be streamlined and conversion vanes shall eliminate turbulence and provide smooth discharge airflow. Enclose fan bearings and drive shafts, and isolate from the airstream. Fan bearings shall be mechanically sealed against dust and dirt and shall be self-aligning, pillow block ball or roller type. Motor and drive shall be provided by fan manufacturer. Provide with speed controller, backdraft

damper, and vibration isolated hanging rod and hardware.

2.2.3.2 Thermostat (for EF-1 only)

- a. Ranges: Thermostat ranges shall be selected so that the setpoint is adjustable without tools between plus or minus 10 degrees F of the setpoint indicated.
- b. Nonmodulating Electric Room Thermostats: Contacts shall be single-pole double-throw (SPDT), hermetically sealed, and wired to identified terminals. Maximum differential shall be 2 degrees F. Thermostat covers shall consist of locking metal or heavy-duty plastic, and shall be capable of being locked by an Allen wrench or special tool. Thermostats shall have manual switches as required by the application and a minimum range of 55 to 90 degrees F.

2.2.4 Charcoal Filter Rack and Filter

Provide activated carbon adsorbers, shall be partial detention, disposable panel type. Each adsorber shall be equipped with a permanent enclosing frame, and four (4) replaceable adsorber panels. Each adsorber shall contain not less than 8.8 pounds of 60% activity coconut shell carbon. Each adsorber shall have a rated airflow of 2,000 CFM, at a resistance not to exceed .25" w.g.

2.3 ELECTRICAL

2.3.1 Electrical Motors, Controllers, Contactors, and Disconnects

Furnish with respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to Section 16402, "Interior Distribution System." Provide electrical connections under Section 16402, "Interior Distribution System." Provide controllers and contactors with maximum of 120-volt control circuits, and auxiliary contacts for use with controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.

2.3.2 Electrical Work

Provide under Section 16402, "Interior Distribution System." Provide control wiring under Section 15910, "Direct Digital Control Systems."

2.4 METAL DUCT SYSTEMS

Provide shop-fabricated ductwork. Fabricate, construct, brace, reinforce, install, support, and seal ducts and accessories in accordance with SMACNA DCS. Provide rectangular ductwork for low pressure applications; except where round is indicated. Cover duct transverse joints with single component synthetic rubber type compound suitable for use with passivated coating on zinc-coated steel. Lap joints in direction of flow. Provide ducts straight and smooth on inside with neatly finished airtight joints. Provide air supply and return openings in ducts with air diffusers,

registers, or grilles.

2.4.1 Ducts of Pressure Classes Less Than 3 Inch WG

Construction, metal gage, hangers and supports, and reinforcements shall conform with SMACNA DCS, except that ducts with pressure classifications below 2 inch water gage that are located outside of the conditioned space shall have a seal Class C. Ductwork shall be airtight and shall not vibrate or pulsate when system is in operation. Pressure sensitive tape shall not be used as a primary sealant on ductwork with pressure classifications above one inch water gage. Duct air leakage shall be less than that allowed by SMACNA HVACADLTM for the duct pressure class, duct seal class, and duct leakage class indicated. Construct ductwork of zinc-coated steel conforming to ASTM A 653/A 653M coating designation G90.

2.4.1.1 Curved Elbows

Make a centerline radius not less than 1 1/2 times the width or diameter of the duct.

2.4.1.2 Laps

Make laps at joints in the direction of airflow. Space button-punch or bolt-connection in standing seams at fixed centers not greater than 6 inches. Longitudinal locks or seams, known as "button-punch snap lock," may be in lieu of Pittsburgh Lock.

2.4.1.3 Fittings

Elbows, vaned elbows, take-offs, branch connections, transitions, splitters, volume dampers, flexible connections, and access doors shall conform with SMACNA DCS, Section 2. Provide factory fabricated, airtight, and noncorrosive test holes with screw cap and gasket.

2.4.2 Flexible Duct Connectors

Provide a minimum of design pressure rated plus 0.5 inch W.G. static pressure airtight flexible duct connectors at duct connections to each air-conditioning unit, air-handling unit, exhaust fan, and ventilating fan. Support connectors at each end with metal angle frame bands, securely bolt in place. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene.

2.4.3 Turning Vanes

Provide fabricated tees and square elbows with double walled turning vanes in accordance with SMACNA DCS for vaned elbows.

2.4.4 Dampers

Provide factory manufactured opposed blade adjustable manual dampers where indicated for duct heights of 12 inches and larger. Provide factory manufactured single leaf dampers for duct heights less than 12 inches. Provide damper shafts with 2 inch standoffs to clear 2 inches of duct

insulation with bearings at both ends of the shafts. Provide adjustment quadrant with indicator and locking devices. Provide galvanized steel dampers one gage heavier than duct in which dampers are installed. Provide automatic dampers under Section 15910, "Direct Digital Control Systems."

2.4.5 Diffusers, Registers, and Grilles

Provide factory-fabricated metal units with edges rolled or rounded where exposed to view, and factory primed with white enamel finish. Do not provide dampers in or on diffusers, registers and grilles. Provide each unit with rubber or plastic installation gaskets. Diffusers in same room shall have same face design.

- a. Diffusers: Provide round, square, or rectangular diffusers as indicated. Ceiling diffusers shall be designed to deliver air in a horizontal direction. Provide baffles or other devices as required for proper air distribution pattern.
- b. Registers: Provide double deflection supply registers arranged to control air direction, throw, and drop. Exhaust and return air registers shall have single set of nondirectional face bars or vanes having the same appearance as supply registers. Provide face bars or vanes spaced not more than 0.75 inch on center and not less than 0.62 inch depth.
- c. Grilles: Provide as specified for registers without air-volume-control dampers.

2.4.6 Access Doors

Provide for access to volume dampers, fire dampers, plenum chambers, and where indicated. Provide each door with double wall zinc-coated steel construction, gasketed airtight, with continuous hinges and cam latches. Insulate access doors with one inch thick rigid insulation. Provide 12 by 12 inch door, except where larger sizes are indicated, or provide 12 inches by height of duct when duct is less than 12 inches high. Provide keyed-alike 90 degree turn cam locks on each access door in sleeping rooms; furnish three keys.

2.4.7 Field-Installed TAB Test Ports

Test ports required for testing by the TAB engineer shall be located in the field by the TAB engineer during TAB field work. It shall be the responsibility of the ductwork contractor to provide and install test ports as required by the TAB engineer.

2.5 PIPING SYSTEMS

Provide the following pipe and fittings. Provide dielectric fittings, unions or flanges between steel piping and copper tubing for all piping sizes; except that copper alloy valves and strainers may be used without dielectric fittings, unions or flanges. Water piping sizes 4 inches and smaller shall be copper tubing.

2.5.1 Copper Refrigerant Tubing

Provide ASTM B 280, cleaned, dehydrated, and sealed. Provide ASME/ANSI B16.22 solder joint refrigerant fittings and adapters. Provide silver brazing alloy solder and silver brazing alloy flux. During brazing operations bleed a small amount of dry oil-free nitrogen continuously through the refrigerant tubing. Provide ASME/ANSI B16.26 flared fittings.

2.5.2 Valves

Valves shall have flanged end connections, except valves smaller than 2.5 inches may have threaded end connections with a union on one side of the valve. Solder end connections may be used for connections between copper alloy valves and copper tubing.

2.5.2.1 Gate Valves

MSS SP-80, Class 125, except sizes 2.5 inches and larger shall conform to MSS SP-70, Class 125.

2.5.2.2 Globe and Angle Valves

MSS SP-80, Class 125, except sizes 2.5 inches and larger shall conform to MSS SP-85, Class 125.

2.5.2.3 Check Valves

MSS SP-80, Class 125, swing check; except sizes 2.5 inches and larger shall conform to MSS SP-71, Class 125.

2.5.2.4 Butterfly Valves

MSS SP-67, except sizes 2.5 inches and larger shall have lugged or wafer body designed for installation between ASME Class 150 flanges. Valves shall have two-position lever handles.

2.5.2.5 Ball Valves

Full port design, copper alloy body, except sizes 2.5 inches and larger shall be cast-iron body. Valves shall have two-position lever handles. Ball valves may be provided in lieu of gate valves.

2.5.3 Specialty Valves

2.5.3.1 Refrigerant Valves

ASME/ANSI B31.5, and shall be copper alloy. Provide valves in each system for servicing and for isolating system components in compliance with ASHRAE 15.

2.6 PIPING ACCESSORIES

2.6.1 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.6.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors. Provide one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

2.6.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or Schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.6.2.2 Sleeves not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.6.3 Flexible Pipe Connectors

Provide flexible bronze or stainless steel piping connectors with single braid where indicated. Connectors shall be suitable for the intended service.

2.6.4 Sight Glass and Refrigerant Drier

ARI 710. Provide in refrigerant liquid piping.

2.6.5 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 HVAC System

Installation of HVAC system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1, ASME/ANSI B31.5, NFPA 70, and in accordance with the manufacturer's recommendations.

3.2 PIPING

Test, inspect, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing fittings; bushings will not be permitted. Install valves with stems horizontal or above. Provide flanges or unions at valves, traps, strainers, and connections to equipment; unions are not required in copper tubing piping systems.

- a. Threaded connections: Provide Teflon pipe thread paste on male threads. Do not thread metal pipe into plastic piping.
- b. Pipe hangers and supports: Provide additional pipe hangers and supports at in-line water pumps and flanged valves.
- c. Piping to receive insulation: Provide temporary wood spacers between the pipe hangers and supports, and the pipe to properly slope the piping and establish final elevations. Provide temporary wood spacers of same thickness as insulation to be provided under Section 15080, "Mechanical Insulation." Support plastic piping every 4 feet. Support metal piping as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	One and under	1.25	1.5	2
Copper Tubing	6	7	8	8
Steel Pipe	7	8	9	10

- d. Cleaning of piping: Keep interior and ends of new piping and existing piping affected by Contractor's operations, cleaned of water and foreign matter during installation by using plugs or other approved methods. When work is not in progress, securely close open ends of pipe and fittings to prevent entry of water and foreign matter. Inspect piping before placing into position.
- e. Tee Joints: Extracted tee joints may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch

tube for proper penetration into fitting to ensure a free flow joint. Braze extracted joints using a copper phosphorous classification brazing filler metal. Soldered joints shall not be permitted.

3.3 ADJUSTMENTS

Adjust controls and equipment so as to give satisfactory operation. Adjust entire water temperature control system and place in operation so that water quantities circulated are as indicated. Air duct systems shall be adjusted and balanced so that air quantities at outlets are as indicated and so that distribution from supply outlets is free from drafts and has uniform velocity over the face of each outlet.

3.4 INSTRUCTING OPERATING PERSONNEL

Upon completion of work and at time designated by Contracting Officer, provide services of competent technician for period of not less than one 8-hour working day for instruction of Government operating personnel in proper operation and maintenance of equipment.

3.5 FIELD QUALITY CONTROL

Upon completion and before final acceptance of work, test each system in service to demonstrate compliance with the contract requirements. Adjust controls and balance systems prior to final acceptance of completed systems. Test controls through every cycle of operation. Test safety controls to demonstrate performance of required function. Correct defects in work provided by Contractor and repeat tests. Furnish steam, fuel, water, electricity, instruments, connecting devices, and personnel for tests. Flush and clean piping before placing in operation. Clean equipment, piping, strainers, ducts, and filters.

3.5.1 Refrigerant Piping

Perform following when field piping connections are provided.

- a. Pressure test: Test refrigerant piping using dry, oil-free nitrogen, and prove tight at 300 psig on the high side and 150 psig on the low side. Maintain pressure for 2 hours with no leakage or reduction in gage pressure.
- b. Evacuation: Using high vacuum pump and certified micron gage, reduce absolute pressure on both sides of system simultaneously to 300 microns. After reaching this point charge system with proper refrigerant until pressure of zero psig is obtained. Repeat evacuation-charging procedure for two more cycles, totaling to three evacuation-charging cycles. On final evacuation, secure pump and maintain 300 microns for 2 hours before charging with required final refrigerant.

3.5.2 Air Ducts

Obtain approval before applying insulation.

3.5.3 Equipment

3.5.3.1 Field Testing

Test each item of equipment in operation for continuous period of not less than 24 hours under every condition of operation in accordance with each equipment manufacturer's recommendation. Verify that the equipment operating parameters are within limits recommended by the manufacturer.

3.5.3.2 Equipment Field Acceptance Test Reports

- a. Equipment requiring field acceptance test reports are listed in paragraph entitled "SD-08 Statements." Each piece of equipment listed as requiring a field test plan shall be field acceptance tested and a test report submitted for approval.
- b. Manufacturer's recommended testing: Conduct the manufacturer's recommend field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field acceptance testing.
- c. Operational test: Conduct a continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every two hours. Use the test report forms for logging the operational variables.
- d. Notice of tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.
- e. Report forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment shall be reviewed, approved, and signed by the Contractor's test director and the QC manager. The manufacturer's field test representative shall review, approve, and sign the report of the manufacturer's recommended test. Signatures shall be accompanied by the person's name typed.
- f. Deficiency resolution: The test requirements acceptably met; deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

3.5.4 Related Field Testing For Small Systems

Requirements for testing, adjusting, and balancing (TAB) of ducts, piping,

and equipment is specified in Section 15949, "HVAC Testing/Adjusting/Balancing for Small HVAC Systems". Provide support personnel and equipment as specified in Section 15949, to assist TAB team to meet the TAB work requirements.

-- End of Section --

SECTION 15910

DIRECT DIGITAL CONTROL SYSTEMS

08/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 500 (1991) Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.18 (1984; R 1994, 1996) Cast Copper Alloy
Solder Joint Pressure Fittings

ANSI C12.10 (1987) Electromechanical Watthour Meters

ANSI C57.13 (1978; R 1987) Instrument Transformers

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AIR-CONDITIONING
ENGINEERS, INC. (ASHRAE)

ASHRAE 3 (1990; Addendum 1992) Reducing Emission of
Fully Halogenated Chlorofluorocarbon (CFC)
Refrigerants in Refrigeration and
Air-Conditioning Equipment and Applications

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.5 (1996) Pipe Flanges and Flanged Fittings

ASME/ANSI B16.22 (1995) Wrought Copper and Copper Alloy
Solder Joint Pressure Fittings

ASME/ANSI B16.26 (1988) Cast Copper Alloy Fittings for
Flared Copper Tubes

ASME/ANSI B16.34 (1996; Addenda 1998) Valves - Flanged,
Threaded, and Welding End

ASME B31.1 (1998) Power Piping

ANSI/ASME B40.1 (1991; Special Notice 1992) Gauges -
Pressure Indicating Dial Type - Elastic
Element

ASME BPVC SEC VIII (1995; Addenda 1995) Boiler and Pressure
Vessel Codes: Section VIII Pressure
Vessels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126 (1995) Gray Iron Castings for Valves,
Flanges, and Pipe Fittings

ASTM B 32 (1996) Solder Metal

ASTM B 75M (1995) Seamless Copper Tube (Metric)

ASTM B 75 (1995; Rev. A) Seamless Copper Tube

ASTM B 88M (1999) Seamless Copper Water Tube (Metric)

ASTM B 88 (1999) Seamless Copper Water Tube

ASTM D 638M (1993) Tensile Properties of Plastics
(Metric)

ASTM D 638 (1995) Tensile Properties of Plastics

ASTM D 792 (1991) Density and Specific Gravity
(Relative Density) of Plastics by
Displacement

ASTM D 1238 (1995) Flow Rates of Thermoplastics by
Extrusion Plastometer

ASTM D 1693 (1995) Environmental Stress-Cracking of
Ethylene Plastics

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 90A (1999) Installation of Air Conditioning
and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION,
INC. (SMACNA)

SMACNA DCS (1995; Addendum 1997) HVAC Duct
Construction Standards - Metal and Flexible

SMACNA HVACTAB (1993) HVAC Systems Testing, Adjusting and
Balancing

UNDERWRITERS LABORATORIES INC. (UL)

UL 506 (1994; R 1997, Bul. 1997) Specialty

Transformers

UL 555S	(1993; Bul. 1994, 1995, and 1996, R 1995) Leakage Rated Dampers for Use in Smoke Control Systems
UL 916	(1994; Bul. 1994 and 1996, R 1996) Energy Management Equipment
UL 1449	(1996; R 2000) Transient Voltage Surge Suppressors

1.2 RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods," applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 BACnet

BACnet is a standard communication protocol under development by the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE). The controller manufacturer shall have a company policy to support the implementation of BACnet as it becomes available.

1.3.2 Digital Controllers

A control module which is microprocessor based, programmable by the user, has integral I/O, and performs stand-alone operations.

1.3.3 Direct Digital Control (DDC)

A digital controller as defined in this document. The controller directly senses building environment and makes control decisions based on user defined, controller resident programs. The controller outputs control signals that directly operate valves, dampers, and motor controllers. No conventional control devices, pneumatic or electronic, such as receiver-controllers, thermostats, and logic units are present within or interface with a direct digital control loop. Actuators are electric or pneumatic, and the controller output is converted to the appropriate type of signal.

1.3.4 DDC System

A system made up of one or more digital controllers. Required climate control and energy management functions for complete operation of an HVAC system are provided by DDC from digital controllers. No conventional control devices (pneumatic or electronic) such as receiver-controllers, thermostats, and logic units are used. Digital controllers in a system are linked in a communications network composed of one or more levels of local area networks (LAN).

1.3.5 Distributed Control

The intent of distributed control is to install the controllers near the equipment being controlled, and to distribute the processing to each standalone DDC panel. The control system is built up of stand-alone controllers, with the total number of utilized sensor inputs and control outputs to be forty-eight or less per controller. Failure of any single module will not cause the loss of more than 48 points.

1.3.6 Dynamic Control

A process that optimizes operation of HVAC systems (air handling units, converters, chillers, and boilers) by increasing and decreasing setpoints or starting and stopping equipment in response to heating and cooling needs of downstream equipment. A requirement of dynamic control is knowing the heating/cooling demand status of downstream equipment, therefore dynamic control requires controllers connected in a communications network.

1.3.7 Firmware

Firmware is software programmed into read only memory (ROM) and erasable programmable read only memory (EPROM) chips. Software may not be changed without physically altering the chip.

1.3.8 Graphic Sequence of Operation

A drawing or graphic showing the all interlocks and control loop sequences between the input and output points. Graphic sequence of operation is a graphical representation of the sequence of operation. The graphic sequence of operation will show all inputs, outputs, and logic blocks.

1.3.9 Hand-Held Terminal

A hand-held terminal is a portable device, control system manufacturer-specific, which can be connected directly to a communications port on a digital controller and through which the digital controller can be interrogated and, in some cases, programmed.

1.3.10 Input/Output (I/O)

I/O refers to analog inputs (AI), digital inputs (DI), analog outputs (AO), and digital outputs (DO) in a digital controller. Inputs are from analog sensors (temperature, pressure, humidity, flow) and digital sensors (motor status, flow switches, switch position, and pulse output devices). Outputs operate modulating and on/off control devices.

1.3.11 I/O Unit

An I/O unit provides additional point capacity to a digital controller and communicate with the stand-alone digital controller on a LAN. An I/O unit is not stand-alone because the control program does not reside in the I/O units microprocessor.

1.3.12 Local Area Network (LAN)

- a. A communications bus that interconnects digital controllers for peer-to-peer communications. Different levels of LANs are possible within a single DDC system. In this case a digital controller on a higher level LAN acts as a network controller to the controllers on the lower level LAN. The network controller, then, has at least two LAN communications ports. One port supports peer-to-peer communications with other digital controllers on the higher level LAN. The other port supports communications with the digital controllers on the lower level LAN.
- b. LANs permit sharing global information, make it possible to apply building wide control strategies such as peak demand limiting, permit dynamic control strategies, allow coordinated response to alarm conditions, and permit remote monitoring and programming of digital controllers.
- c. Facility-wide LAN refers to a commercially available local area network. These LANs allow the connection to an existing or new facility-wide LAN.

1.3.13 Microprocessor

A microprocessor refers to the central processing unit (CPU) that contains all the registers and logic circuitry that make it possible for digital controllers to do computing.

1.3.14 Output Signal Conversion

Output signal conversion refers to the changing of one kind of control output into a proportionally related signal appropriate for direct actuation of the controlled device. Signals are converted by a transducer which may be external to the digital controller originating the output.

- a. Examples in modulating control of pneumatic actuators are conversion of 4-20 ma signals into proportional 3-15 psig signals.
- b. An example of output signal conversion in on/off or open/close control is a contact closure originating in a digital controller which activates a solenoid air valve which passes main air, thereby forcing a damper to open fully.

1.3.15 Optimum Start

Optimum Start is a method of starting the HVAC equipment prior to occupancy time in order to have the building at setpoint at occupancy. Optimum start shall be based on the zone temperatures, zone setpoints, and outdoor temperature. Optimum start will bring the zone to setpoint at occupancy time.

1.3.16 Peer-to-Peer

Peer-to-peer refers to controllers connected on a communications LAN that act independently, as equals and communicate with each other to pass information which facilitate control.

1.3.17 PID

PID refers to proportional, integral, and derivative control; the three types of action that are used in controlling modulating equipment.

1.3.18 Resolution

Refers to the number of possible states an input value or output value can take and is a function of the digital controller I/O circuitry; the A/D converter for input and the D/A converter for output. Ten bit resolution has 1024 possible states and eight bit resolution has 256 possible states.

1.3.19 Stand-Alone Control

Refers to the digital controller being able to perform required climate control, and energy management functions without connection to another digital controller or central site computer. Digital controller requirements for stand-alone control are a time clock, a microprocessor, microchip resident control programs, PID control, a communications port for interfacing with and programming the controller, firmware for interrogation and programming, and I/O for sensing and effecting control of its control environment.

1.3.20 Terminal Control Unit (TCU)

An off-the-shelf, stand-alone digital controller equipped for communication on a lower level local area network. TCUs may deviate from stand-alone only in receiving energy management and time information from a stand alone digital controller. A TCU is commonly application specific and is used for distributed control of specific HVAC subsystems. A TCU communicates with the digital controllers. Typically, a TCU communicates on a lower level LAN. Examples where TCUs might be used are control of small air handling units (AHUs), variable air volume (VAV) boxes, fan coil units, and heat pumps.

1.4 DDC SYSTEM DESCRIPTION

- a. Provide a new Siemens Building Technologies DDC System including associated equipment and accessories. The new system in the MCAF Armory building shall be connected to and become an integral part of the existing Siemens Building Technologies System 600 DDC System serving the Marine Corps Base Quantico. The new system shall be fully compatible with and shall be controlled directly from the existing central system in Building 3252 utilizing Siemens APOGEE software, including the downloading of software, programs, operating parameters, and the automatic interrogation of all points connected to this system. Provide each control system complete, and operating as specified. Manufacturer's products, including design, materials, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1 and NFPA 70, except as modified herein or indicated otherwise.

- b. Provide the DDC systems to maintain stable temperature control and all other conditions as indicated. The end-to-end accuracy of the system, including temperature sensor error, wiring error, A/D conversion, and display, shall be 1 degree F.

1.4.1 Design Requirements

1.4.1.1 Control System Schematic

Provide control system schematic that includes the following:

- a. Location of each input and output device
- b. Flow diagram of each HVAC component, for instance flow through coils, fans, dampers
- c. Name or symbol for each component such as V-1, DM-2, T-1 for a valve, damper motor, and temperature sensor, respectively
- d. Setpoints
- e. Sensor range
- f. Actuator range
- g. Valve and damper schedules and normal position
- h. Switch points on input switches
- i. Written sequence of operation for each schematic
- j. Graphic sequence of operation for each schematic
- k. Schedule identifying each sensor and controlled device with the following information:
 - (1) Software point name
 - (2) Point type (AO, AI, DO, DI)
 - (3) Point range (4 to 20 ma, 3 to 15 psi, 100 or 1000 ohm platinum RTD, 10,000 ohm thermistor)
 - (4) Digital controller number to which the point connects.

1.4.1.2 Electrical Equipment Ladder Diagrams

Submit diagrams showing electrical equipment interlocks, including voltages and currents.

1.4.1.3 Component Wiring Diagrams

Submit a wiring diagram for each type of input device and each type of output device. Diagram shall show how the device is wired and powered;

showing typical connections at the digital controller and each power supply, as well as at the device itself. Show for all field connected devices, including, but not limited to, control relays, motor starters, electric or electronic actuators, and temperature, pressure, flow, proof, and humidity sensors and transmitters.

1.4.1.4 Terminal Strip Diagrams

Submit a diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and the associated point names.

1.5 SUBMITTALS

Submit manufacturers' specification sheets for each type of equipment to show compliance with the project specification. For each type of equipment highlight each compliance item and reference each item to the relevant specification paragraph number. Submit sufficient manufacturers' information to allow verification of compliance by the reviewing authority.

Equipment and software for which specification compliance data shall be submitted includes but is not limited to the following:

SD-01 Preconstruction Submittals

List of shop drawings G

List of symbols and abbreviations used on shop drawings G

List of I/O points G

Equipment components list G

AC power table G

SD-02 Shop Drawings

Control system schematic G

Ladder diagrams G

Component wiring diagrams G

Terminal strip diagrams G

SD-03 Product Data

DDC hardware G

DDC capabilities G

Workstation software G

Input devices G

Output devices G

Surge and transient protection G

Hand-held terminal G

Panel mounted display and keypad G

SD-05 Design Data

Temperature sensor accuracy G

Temperature sensor five year stability G

SD-06 Test Reports

Field tests G

Performance verification tests G

SD-07 Certificates

Direct digital controllers G

Test equipment accuracy G

Contractors' qualifications G

Training course materials G

SD-10 Operation and Maintenance Data

Controls and HVAC System Operators Manual G

DDC Manufacturer's Hardware and Software Manuals G

SD-11 Closeout Submittals

Posted operating instructions:

Administrative and closeout submittals:

Training course documentation G

Service organization G

Contractor certification G

1.6 STORAGE

Stored products shall be protected from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.

1.7 QUALITY ASSURANCE

1.7.1 Standard Products

- a. Material and equipment shall be standard products of manufacturer regularly engaged in the manufacturing of such product, using similar materials, design and workmanship. The standard products shall have been in commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of similarly sized equipment and materials used under similar circumstances and sold on the commercial market through advertisements, manufacturers' catalogs, or brochures.
- b. Products are supported by a local service organization.

1.7.1.1 DDC Hardware

- a. I/O type and characteristics
- b. Resident programs
- c. Communications ports
- d. Protected memory
- e. Operating temperature limits

1.7.1.2 DDC Capabilities

- a. Communications; baud rates, communication ports, hierarchy
- b. Trending capabilities
- c. Alarming capabilities; capable of alarm generation as defined in this specification
- d. Messaging capabilities
- e. Self diagnostic capabilities
- e. PID control capabilities

1.7.1.3 Workstation Software

- a. Communications
- b. DDC Program download capability
- c. Dynamic point update
- d. Program modification

1.7.1.4 Input Devices

- a. Transmitters
- b. Temperature sensors
- c. Pressure sensors
- d. Flow or motor proof

1.7.1.5 Output Devices

- a. Dampers
- b. Valves
- c. Actuators
- d. Control relays

1.7.1.6 Surge and Transient Protection

- a. Power line
- b. Communications lines
- c. Controller I/O

1.7.2 Nameplates and Tags

- a. Nameplates bearing legends as shown and tags bearing device unique identifiers as shown shall be engraved or stamped. Nameplates shall be permanently attached to HVAC control panel doors.
- b. For each field mounted piece of equipment, not in a finished area, a plastic or metal tag with equipment name and point identifier shall be attached.

1.7.3 Verification of Dimensions

The contractor shall become familiar with all details of the work, shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.7.4 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, and shall furnish all work necessary to meet such conditions.

1.7.5 List of Shop Drawings

Provide a list of shop drawings.

1.7.6 List of Symbols and Abbreviations Used on Shop Drawings

Provide an index of symbols and abbreviations used on the shop drawings.

1.7.7 List of I/O Points

For each input and output physically connected to a digital controller provide, on a controller by controller basis, provide the following:

- a. Point description: for example: mixed air temperature, supply fan start/stop, etc.
- b. Point type: AO, AI, DO, or DI.
- c. Point range: 4-20 ma, 3-15 psi, platinum RTD resistance ohm, thermistor.
- d. Sensor range associated with point range: for example 0-100 degrees F, 0-2 inches of water.
- e. Software name(s) associated with point, if any.
- f. Terminal number to which point is connected.

1.7.8 Equipment Components List

Submit a listing of controllers and connected devices shown on control system schematic. List the following:

- a. Control system schematic component name
- b. Description
- c. Manufacturer of controller
- d. Controller's name
- e. Equipment part numbers
- f. Cv for valves
- g. For actuators:
 - (1) Motive force (such as electric)
 - (2) Normal position
 - (3) Nominal operating range (such as 4 to 8 mA)

1.7.9 AC Power Table

Submit a table listing each controller and the circuit breaker number, panel box number, and physical location of each controller's source of AC power. All DDC controllers including TCU's shall have dedicated sources of

power not associated with the equipment controlled.

1.7.10 Contractors Qualifications

- a. The Contractor or subcontractor that will perform the work, with whom the Contractor has a firm contractual agreement, shall have completed at least three DDC systems installations of the same type and design specified, that have successfully operated the required sequence of operation for at least one year.
- b. The programmer responsible for programming the digital controllers shall have a minimum of 2 years experience programming digital controllers, of the same manufacturer, for HVAC systems.

1.7.11 Training Course Documentation

Training course documentation shall include a manual for each trainee plus two additional copies and two copies of audiovisual training aids, if used.

Documentation shall include an agenda, defined objectives for each lesson and detailed description of the subject matter of each lesson.

1.7.12 Service Organization

Qualified service organization list that shall include the names and telephone numbers of organizations qualified to service the HVAC control systems.

1.7.13 Contractor Certification

Provide certification that the installation of the control system is complete and the technical requirements of this section have been met.

1.7.14 Controls and HVAC System Operators Manual

Provide two copies of a Control and HVAC Systems Operators Manual. Provide in a 3 ring binder with a minimum of the following 7 sections. Use tabs to divide each section.

- a. Description of HVAC Systems: Provide a description of the HVAC system components and control system. Include sequence of operation and a complete points list.
- b. Controls Drawings: Provide drawings as specified in submittal paragraph.
- c. Control Program Listings: Provide listing of all control programs, including terminal equipment controller setup pages if used.
- d. Current Operating Parameters: Provide printouts of input and output setup information, (database setups). This section provides information such as point addresses, slopes and offsets for all points, database of points, etc.

- e. Design Information: Provide tab, but leave this section blank.
- f. Control Equipment Technical Data Sheets: Provide technical data sheets for all controller hardware and accessories.
- g. Backup of Control Program: Provide backup copies of the control program and ACAD control drawings on CD-ROM.

1.7.15 DDC Manufacturer's Hardware and Software Manuals

Provide the following manuals.

- a. Installation and Technical Manuals for all digital controller hardware.
- b. Installation and Technical Manuals for workstation.
- c. Operator Manuals for all digital controllers.
- d. Operator Manuals for all workstation software.
- e. Programming Manuals for all digital controllers.
- f. Programming Manuals for workstation software.

1.7.16 Support

Certified local technical support shall exist within 3 hours of the site.

1.7.17 Modification of References

The advisory provision in ASME B31.1 and NFPA 70 shall be considered mandatory. Substitute the word "shall" for "should" wherever it appears and interpret all references to the "authority having jurisdiction" and "owner" to mean the Contracting Officer.

PART 2 PRODUCTS

2.1 DDC SYSTEM

- a. Provide a DDC system as a distributed control system manufactured and installed by Siemens Building Technologies. The system shall have stand-alone digital controllers and a communications network. Software shall be an extension of and compatible with Siemens Building Control Apogee software version 3.1 or higher existing on site.
- b. Provide a operator programmable system, based on the user applications, to perform closed-loop, modulating control of building equipment. Connect all digital controllers through the communication network to share common data and report to workstation computers. The workstation computers will be capable of being programmed to supervise the digital controllers. The control system shall be capable of down-loading and up-loading of

programs between the existing workstation and the digital controllers.

- c. Provide the quantity of digital controllers that will perform required climate control, energy management, and alarm functions. All material used shall be currently in production.

2.1.1.1 Direct Digital Controllers

DDC hardware shall be UL 916 rated.

2.1.1.1.1 Distributed Control

Apply digital controllers in a distributed control manner.

2.1.1.1.2 I/O Point Limitation

Total number of I/O hardware points connected to a single stand-alone digital controller shall not exceed 48. I/O expansion units are not permitted. Multiplexing of I/O is not permitted.

2.1.1.1.3 Environmental Operating Limits

Provide digital controllers that operate in environmental conditions between 32 and 120 degrees F.

2.1.1.1.4 Stand-Alone Control

Provide stand-alone digital controllers.

2.1.1.1.5 Internal Clock

Provide clock with each controller on the highest level local area network (LAN) shall have its clock backed up by a battery or capacitor with sufficient capacity to maintain clock operation for a minimum of 72 hours during a line power outage.

2.1.1.1.6 Memory

- a. Provide sufficient memory for each controller to support required control and communication functions.
- b. Memory Protection: Programs residing in memory shall be protected either by using EEPROM or by an uninterruptible power source (battery or uninterruptible power supply (UPS)). The backup power source shall have sufficient capacity to maintain volatile memory in event of an AC power failure. Where the uninterruptible power source is rechargeable (a rechargeable battery), provide sufficient capacity for a minimum of seventy-two hours back-up. The rechargeable power source shall be constantly charged by charging circuitry while the controller is operating under normal line power. Where a nonrechargeable power source is used, provide sufficient capacity for a minimum of two years accumulated power failure. Batteries shall be designed to allow replacement without

soldering.

2.1.1.7 Inputs

Provide input function integral to the direct digital controller. Provide input type as required by the DDC design.

- a. Analog Inputs: Allowable input types are three wire 100 ohm or higher platinum RTDs, stable 10,000 ohm thermistors, and 4 to 20 mA. Thermistor and direct RTD inputs must have appropriate conversion curves stored in controller software or firmware. Analog to digital (A/D) conversion shall be a minimum of 10 bit resolution.
- b. Digital Inputs: Digital inputs shall sense open/close, on/off, or other two state indications.

2.1.1.8 Outputs

Provide output function integral to the direct digital controller. Provide output type as required by the DDC design.

- a. Analog Outputs: Provide controllers with a minimum output resolution of 8 bits. Output shall be 4 to 20 ma or 3 to 15 psi. Each pneumatic output shall have feedback for monitoring of the actual pneumatic signal. Feedback shall be integral to the output function.
- b. Digital Outputs: Provide contact closure with contacts rated at a minimum of 1 ampere at 24 volts.

2.1.1.9 PID Control

Provide controllers with proportional, proportional plus integral, and proportional plus integral plus derivative control capability. Terminal controllers are not required to have the derivative component.

2.1.1.10 Digital Controller Networking Capabilities

The upper level digital controllers shall be capable of being networked with other similar upper level controllers. Upper level controllers shall also be capable of communicating over a network between buildings.

2.1.1.11 Communications Ports

- a. Controller-to-Controller LAN Communications Ports: Controllers in the building DDC system shall be connected in a communications network. Controllers shall have controller to controller communication ports to both peer controller (upper level controllers) and terminal controllers (lower level controllers). Network may consist of more than one level of local area network and one level may have multiple drops. Communications network shall permit sharing between controllers of sensor and control information, thereby allowing execution of dynamic control

strategies and coordinated response to alarm conditions. Minimum baud rate for the lowest level LAN shall be 9600 Baud. Minimum baud rate for the highest level LAN shall be 9600 Baud. Minimum baud rate for a DDC system consisting of a single LAN shall be 9600 Baud.

- b. On-Site Interface Ports: Provide a RS-232, RS-485, or RJ-11 communications port for each digital controller that allows direct connection of a computer or hand held terminal and through which the controller may be fully interrogated. Controller access shall not be limited to access through another controller. On-site interface communication ports shall be in addition to the communications port(s) supporting controller to controller communications. Communication rate shall be 9600 Baud minimum. Every controller on the highest level LAN shall have a communications port supporting direct connection of a computer; a hand held terminal port is not sufficient. By connecting a computer to this port, every controller in the direct digital control system shall be able to be fully interrogated and programmed. The following operations shall be available: downloading and uploading control programs, modifying programs and program data base, and retrieving or accepting trend reports, status reports, messages, and alarms.
- c. Telecommunications Interface Port: Provide one additional telecommunications port in each DDC system permitting remote communications via telephone. All operations possible by directly connecting a computer to a controller at the highest level LAN shall be available through the telecommunications port. A telecommunications port provided on a digital controller shall be in addition to the port required for directly connecting a computer to the controller. Telecommunication baud rate shall be 56,600 minimum.

2.1.1.12 Modem

Provide one Hayes compatible modem per DDC system to communicate between the digital control system and the existing workstation.

2.1.1.13 Digital Controller Cabinet

Each digital controller cabinet shall protect the controller from dust and be rated NEMA 1, unless specified otherwise. Controller cabinets, or enclosures the controller is mounted in shall be lockable.

2.1.1.14 Main Power Switch

Each controller on the highest level LAN shall have a main power switch for isolation of the controller from AC power. The switch shall be protected from tampering within the DDC cabinet.

2.1.2 Terminal Control Units

- a. TCUs shall be manufactured by the same company as the digital

controllers.

- b. TCUs shall automatically start-up on return of power after a failure, and previous operating parameters shall exist or shall be automatically downloaded from a digital controller on a higher level LAN.
- c. TCUs do not require an internal clock, if they get time information from the digital controller.

2.1.3 DDC Software

Software resides in the digital controllers and performs control sequences.

2.1.3.1 Sequence of Control

Provide, in the digital controllers, software to execute the sequence of control. Provide sequence of control written in both text and graphic format.

2.1.3.2 Database Modification

Provide software to modify the control program database. Database modification shall be accomplished through connected computer or hand held terminal or through a keypad integral to the controller. Database modification shall be accomplished without having to make changes directly in line-by-line programming. As a result of this requirement, when the control program is of the line-by-line type, database parameters in the following list that take real number values shall require assignment of variable names so parameters can be changed without modifying the line-by-line programming. Alternatively, block programming languages shall provide for modification of these database parameters in fill-in-the-blank screens. The following shall be modifiable in this way:

- a. Setpoints
- b. Deadband limits and spans
- c. Reset schedules
- d. Switchover points
- e. PID gains and time between control output changes
- f. Time
- g. Timed local override time
- h. Occupancy schedules
- i. Holidays
- j. Alarm points, alarm limits, and alarm messages

- k. Point definition database
- l. Point enable, disable, and override
- m. Trend points, trend intervals, trend reports
- n. Analog input default values
- o. Passwords
- p. Communications parameters including network and telephone communications setups

2.1.3.3 Differential

Where equipment is started and stopped or opened and closed in response to some analog input such as temperature, pressure, or humidity, include a differential for the control loop to prevent short cycling of equipment.

2.1.3.4 Motor and Flow Status Delay

Provide an adjustable delay between when a motor is commanded on or off and when the control program looks to the motor or flow status input for confirmation of successful execution of the command.

2.1.3.5 Runtime Accumulation

Provide resettable run time accumulation for each controlled electrical motor.

2.1.3.6 Timed Local Override

Provide user definable adjustable run time for each push of a momentary contact timed local override. Pushes shall be cumulative with each push designating the same length of time. Provide a user definable limit on the number of contact closures summed, such as 6, before the contact closures are ignored. Timed local overrides are to be disabled during occupancy periods.

2.1.3.7 Time Programs

Provide programs to automatically adjust for leap years, and make daylight savings time and standard time adjustments.

2.1.3.8 Scheduling

- a. Each control output point shall be schedulable and its operation based on time of day, day of week, and day of year. Output points may be associated into groups. Each group may be associated with a different schedule. Changing the schedule of a group shall change the schedule of each point in the group. Points may be added to and deleted from groups. Groups may be created and deleted by the operator.

- b. Provide capability that will allow current schedules to be viewed and modified in a seven day week format. When control program does not automatically compute holidays, provide capability to allow holiday schedules to be entered one full year at a time.

2.1.3.9 Point Override

I/O and virtual points shall be able to be software overridden in the software and commanded to any possible value.

2.1.3.10 Alarming

I/O points and virtual points shall be alarmable. Alarms may be enabled and disabled for every point. Alarm limits shall be adjustable on analog points. Controllers connected to an external communications device such as a printer, terminal, or computer, shall download alarm and alarm message when alarm occurs. Otherwise alarms will be stored and automatically downloaded when a communications link occurs. The following conditions shall generate alarms:

- a. Motor is commanded on or off but the motor status input indicates no change
- b. Room temperature or pressure strays outside selectable limits
- c. An analog input takes a value indicating sensor failure
- d. A module is "dead" to the LAN
- e. A power outage occurs

2.1.3.11 Messages

Messages shall be operator defined and assigned to alarm points. Messages shall be displayed when a point goes into alarm.

2.1.3.12 Trending

DDC system shall have the capability to trend I/O and virtual points. Points may be associated into groups. A trend report may be set up for each group. The period between logging consecutive trend values shall range from one minute to 60 minutes at a minimum. Trend data type shall be selectable as either averages over the logging period or instantaneous values at the time of logging. The minimum number of consecutive trend values stored at one time shall be 30 per variable. When trend memory is full, the most recent data shall overwrite the oldest data. Trend data shall be capable of being uploaded to computer. Trend data shall be available on a real time basis; trend data shall appear either numerically or graphically on a connected computer's screen as the data is being processed from the DDC system data environment. Trend reports shall be capable of being uploaded to computer disc and archived.

2.1.3.13 Status Display

Current status of I/O and virtual points shall be displayed on command. Points shall be associated into functional groups, such as all the I/O and virtual points associated with control of a single air handling unit, and displayed as a group, so the status of a single mechanical system can be readily checked. A group shall be selectable from a menu of groups having meaningful names; such as AHU-4, Second Floor, Chiller System, and other such names.

2.1.3.14 Diagnostics

Each controller shall perform self-diagnostic routines and provide messages to an operator when errors are detected. DDC system shall be capable of recognizing a nonresponsive module on a LAN. The remaining, responsive modules on a LAN shall not operate in a degraded mode.

2.1.3.15 Power Loss

In event of a power outage, each controller shall assume a disabled status and outputs shall go to an user definable state. Upon restoration of power, DDC system shall perform an orderly restart, with sequencing of outputs.

2.1.3.16 Program Transfer

Provide software for download of control programs and database from a computer to controllers and upload of same to computer from controllers. Every digital controller in the DDC system shall be capable of being downloaded and uploaded to through a single controller on the highest level LAN.

2.1.3.17 Password Protection

Provide at least three levels of password protection to the DDC system permitting different levels of access to the system.

2.1.4 Workstation - Existing in Building 3252

2.1.4.1 Software - Existing Siemens Building Technology i.e. "APOGEE".

Workstation software shall be recommended and supported by the DDC system manufacturer and configured to operate according to the DDC system manufacturer's specifications. Workstation software shall be resident in the workstation computer. Workstation software shall permit monitoring and troubleshooting of the DDC system. Workstation software permits modification of the controller database and control programs. Operations shall be menu selected. Menu selections shall be made with a mouse.

- a. Menu System: Menu system shall allow an operator to select a particular function or access a particular screen through successive menu penetration.
- b. Controller Data Base Modification: The workstation software shall be an interface for performing capabilities specified in paragraph entitled "DDC Software" and available through direct connection of

a computer to a digital controller. Database modification shall require only that an operator "fill in the blank" for that parameter on a screen requesting the information in plain language. Database modifications shall be automatically downloaded to the appropriate controllers at operator request.

- c. Program modification: For systems using a line-by-line programming language, provide an off-line text editor, similar to a BASIC program editor, permitting modification of controller resident control programs, For systems using block programming languages provide a capability for linking blocks together to create new programs or modify existing programs. Program modifications shall be automatically downloaded to the appropriate controllers at operator request.

2.1.4.2 Graphic-Based Software

The intent of graphic-based software is to provide an ergonomic interface to the DDC system that encourages effective and efficient interaction with the system. Graphic-based software shall provide graphical representation of the building, the buildings mechanical systems, and the DDC system. The current value and point name of every I/O point shall be shown on at least one graphic and in its appropriate physical location relative to building and mechanical systems.

- a. Graphics shall closely follow the style of the control drawings in representing mechanical systems, sensors, controlled devices, and point names.
- b. Graphic Title: Graphics shall have an identifying title visible when the graphic is being viewed.
- c. Dynamic Update: When the workstation is on-line with the control system, point data shall update dynamically on the graphic images.
- d. Graphic Penetration: Provide graphic penetration when the capability exists. For systems without graphic penetration, provide menu penetration for selection of individual graphics to give the same hierarchical affect provided by graphic penetration.
- e. Graphic Types: Graphic-based software shall have graphics of the building exterior, building section, floor plans, and mechanical systems. Provide the following graphics.
 - (1) Building Exterior Graphic: Show exterior architecture, major landmarks, and building number.
 - (2) Building Section Graphic: Show stacked floors in section graphic with appropriate floor name on each floor.
 - (3) Floor Plan Graphics: Provide a single graphic for each floor, unless the graphic will contain more information than can reasonably be shown on a single graphic. Each heating or cooling zone within a floor plan shall have a zone name and its current

temperature displayed within the zone outline. Show each controlled variable in the zone. Provide visual indication for each point that is in alarm.

(4) Mechanical System Graphics: Provide two-dimensional drawings to symbolize mechanical equipment; do not use line drawings. Show controlled or sensed mechanical equipment. Each graphic shall consist of a single mechanical system; examples are a graphic for an air handling unit, a graphic for a VAV box, a graphic for a heating water system, and a graphic for a chiller system. Place sensors and controlled devices associated with mechanical equipment in their appropriate locations. Place point name and point value adjacent to sensor or controlled device. Provide visual indication of each point in alarm. Condition, such as zone temperature, associated with the mechanical system shall be shown on the graphic. Point values shall update dynamically on the graphic.

- f. Graphic Editing: Full capacity as afforded by a draw software package shall be included for operator editing of graphics. Graphics may be created, deleted, and modified, and text added. Provide capability to store graphic symbols in a symbol directory and incorporate these symbols into graphics. A minimum of sixteen colors shall be available.
- g. Dynamic Point Editing: Provide full editing capability for deleting, adding, and modifying dynamic points on graphics.
- h. Trending: Trend data shall be displayed graphically, with control variable and process variable plotted as functions of time on the same chart. Graphic display of trend data shall be a capability internal to the workstation software and not a capability resulting from download of trend data into a third-party spreadsheet program such as Lotus, unless such transfer is automatic and transparent to the operator, and the third-party software is included with the workstation software package. At the operator's discretion trend data shall be plotted real time.

2.1.5 Maintenance Personnel Interface Tools

Provide a notebook computer for field communication with the digital controllers. In addition to changing setpoints, and making operational changes, field personnel shall be able to upload and download programs with the notebook computer. Also provide a hand-held terminal or panel displays and keypads or a second notebook computer for the interrogation of the digital controllers at the job site.

2.1.5.1 Hand-Held Terminal

Provide hand-held operators terminal, recommended by the digital controller manufacturer, and a direct connection cable to communicate with the digital controller.

2.1.5.2 Panel Mounted Display and Keypad

Provide panel mounted displays and keypads connected to each digital controller to communicate with the digital controllers

2.2 SENSORS AND INPUT HARDWARE

2.2.1 Field Installed Temperature Sensors

2.2.1.1 Thermistors

Precision thermistors may be used in temperature sensing applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between the range of 32 to 150 degrees F. Sensor manufacturer shall utilize 100 percent screening to verify accuracy. Thermistors shall be pre-aged, and inherently stable. Stability error of the thermistor over five years shall not exceed 0.25 degree F cumulative. Sensor element and leads shall be encapsulated. Bead thermistors are not allowed. A/D conversion resolution error shall be kept to 0.1 degree F. Total error for a thermistor circuit shall not exceed 0.5 degree F, which includes sensor error and digital controller A/D conversion resolution error. Provide thermistor and digital controller manufacturer documentation and the Contractor's engineering calculations which support the proposed thermistor input circuit will have a total error of 0.5 degree F or less. Provide 18 gage twisted and shielded cable for thermistors.

2.2.1.2 Resistance Temperature Detectors (RTDs)

Provide RTD sensors with 1000 ohm, or higher, platinum element that are compatible with the digital controllers. Sensors shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor five year stability error shall not exceed 0.25 degree F cumulative. Total error for a RTD circuit shall not exceed 0.5 degree F, which includes sensor error, lead resistance error, and A/D conversion resolution error. Provide manufacturer documentation and the Contractor's engineering calculations which support the proposed RTD circuit will have a total error of 0.5 degree F or less for the specified application.

a. Wiring:

(1) Provide 18 gage twisted and shielded pair cable for direct connected RTDs.

(2) Provide 18 gage twisted and shielded pair cable for RTDs using 4 to 20 milliampere transmitters.

2.2.1.3 Temperature Sensor Details

- a. Room: Conceal element behind protective cover matched to the room interior. Room temperature sensor shall have integral pushbutton, digital input to the controller for system override, and a setpoint adjustment, analog input to the controller. Digital sensors that communicate directly with the terminal control unit

are acceptable.

- b. Duct Averaging Type: Continuous averaging RTDs for ductwork applications shall be 1 foot in length for each 4 square feet of ductwork cross-sectional area with a minimum length of 6 feet. Probe type duct sensors of 1 foot length minimum are acceptable in ducts 12 feet square and less.
- c. Immersion Type: Three inches total immersion for use with sensor wells, unless otherwise indicated.
- d. Sensor Wells: Brass and stainless steel materials as indicated; provide thermal transmission material compatible with the immersion sensor. Provide heat-sensitive transfer agent between exterior sensor surface and interior well surface.
- e. Outside Air Type: Provide element on the buildings north side with sunshade to minimize solar effects. Mount element at least 3 inches from building outside wall. Sunshade shall not inhibit the flow of ambient air across the sensing element. Shade shall protect sensing element from snow, ice, and rain.

2.2.2 Transmitters

Transmitters shall have 4 to 20 ma output linearly scaled to the temperature, pressure, humidity, or flow range being sensed. Transmitter shall be matched to the sensor, factory calibrated, and sealed. Total error shall not exceed 0.1 percent of 20 milliampere (0.02 milliampere) at any point across the 4 to 20 ma span. Supply voltage shall be 24 volts ac or dc. Transmitters shall have noninteractive offset and span adjustments. For temperature sensing, transmitter stability shall not exceed 0.09 degrees F a year.

2.2.3 Input switches

2.2.3.1 Differential Static Pressure Switch

Provide diaphragm type differential static pressure switches for binary (two-position) operation as specified in sequence of operation. Devices shall withstand pressure surges up to 150 percent of rated pressure. Contacts shall be single pole double throw and switch may be wired for normally open or normally closed operation. Trip set point shall be adjustable. Pressure switch shall be sized so that operating pressure trip point is approximately midpoint of pressure switch adjustable range. Repetitive accuracy shall be 2 percent.

2.2.3.2 Induced Current Operated Solid State Switches

Provide adjustable ranging to monitor continuous loads up to 200 amperes. Switch shall indicate whether it is normally open or normally closed. Limit off-state leakage to 2 milliampere or less.

2.2.3.3 Timed Local Override

Provide momentary contact push button override with override time set in controller software. Provide to override DDC time of day program and activate occupancy program for assigned units. Upon expiration of override time, the control system shall return to time-of-day program. Time interval for the length of operation shall be software adjustable and shall expire unless reset.

2.3 OUTPUT HARDWARE

2.3.1 Dampers

Damper shall conform to SMACNA DCS.

- a. A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sized damper shall be made from a combination of sections.
- b. Dampers shall be steel, stainless steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blades shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 20 cfm per square foot at 4 inches water gage static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 degrees F to 200 degrees F. Dampers shall be rated at not less than 2000 fpm air velocity. All blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section will not be located directly in the air stream. Damper axles shall be 0.5 inch (minimum) plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inch water gage at 1000 fpm in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500.
- c. Operating links external to dampers (such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers) shall withstand a load equal to twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed position of dampers.

2.3.2 Actuator

Provide electric type with spring or capacitance return so that, in the event of power failure, actuators shall fail safe in either the normally open or normally closed position as specified. Actuators shall be quiet operating and function properly within the range of 85 to 110 percent of the motive power. Provide a minimum of one actuator for each damper.

2.3.2.1 Electric Actuators

Provide direct drive electric non-hydraulic actuators for all damper and valve control applications. When operated at rated voltage, each operator shall be capable of delivering the torque required for continuous uniform movement of the valve or damper and shall have end switch to limit travel or shall withstand continuous stalling without damage. Operators shall function properly with range of 85 to 110 percent of line voltage. Provide gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torques less than 16 inch pounds. Provide hardened steel running shafts in sleeve bearing of copper alloy, hardened steel, nylon, or ball bearing. Provide two-position operators of the single direction, spring return, or reversing type. Provide proportioning operators capable of stopping at all points in the cycle and starting in either direction, from any point. Provide reversing and proportioning operators with limit switches to limit travel in either direction unless operator is stall type.

Equip valve operators with a force limiting device such as spring yield so that, when in a relaxed position, device shall maintain a pressure on valve disc equivalent to system pressure at valve. Provide reversible shaded pole, split capacitor, synchronous, or stepper type electric motors.

2.3.3 Output Switches

2.3.3.1 Control Relays

Shall be double pole, double throw (DPDT), UL listed, with contacts rated to the application, and enclosed in a dustproof enclosure. Equip with a light indicator which is lit when coil is energized and is off when coil is not energized. Relays shall be socket type, plug into a fixed base, and be replaceable without need of tools or removing wiring.

2.4 ELECTRICAL POWER AND DISTRIBUTION

Provide a source 120 volts or less, 60 hz, two-pole, three wire with ground. Devices shall be UL listed or FM approved.

2.4.1 Transformers

Transformers shall conform to UL 506. Power digital controllers and terminal control units (TCU's) from dedicated circuit breakers with surge protection specified. Transformers for digital controllers serving terminal equipment on lower level LANs may be grouped to have specified surge protection sized for the number of controllers on a single transformer. Provide a fuse cutout on the secondary side of the transformer.

2.4.2 Surge Protection

Surge and transient protection consist of devices installed externally to digital controllers.

2.4.2.1 Power Line Surge Protection

Surge suppressors external to digital controller, shall be installed on all

incoming AC power. Surge suppressor shall be rated by UL 1449, and have clamping voltage ratings below the following levels:

- a. Unit is a transient voltage surge suppressor 120 VAC/1 phase/2 wire plus ground, hard wire individual equipment protector.
- b. Unit must react within 5 nanoseconds and automatically reset.
- c. Voltage protection threshold, line to neutral, starts at no more than 211 volts peak on the 120 VAC line.
- d. The transient voltage surge suppressor must have an independent secondary stage equal to or greater than the primary stage joule rating.
- e. The primary suppression system components must be pure Silicon Avalanche Diodes.
- f. Silicon Avalanche Diodes or Metal Oxide Varistors are acceptable in the independent secondary suppression system.
- g. The Transient Suppression System shall incorporate an indication light which denotes whether the primary and/or secondary transient protection components is/are functioning.
- h. All system functions of the Transient Suppression System must be individually fused and not short circuit the AC power line at any time.
- i. The Transient Suppression System shall incorporate an EMI/RFI noise filter with a minimum attenuation of 13 db at 10 KHz to 300 MHz.
- j. The system must comply with IEEE C62.41, Class "B" requirements and be tested according to IEEE C62.45.
- k. Manufacturer's quality management systems must be certified ISO 9001 compliant and submit a certificate of registration showing registration accredited by ANSI-RAB.
- l. The system shall have a minimum 3 year full replacement warranty.
- m. The system shall operate at 4 degrees F to +122 degrees F.

2.4.2.2 Telephone and Communication Line Surge Protection

Provide transient surge protection to protect the DDC controllers and LAN related devices from surges that occur on the phone lines (modem or direct connect) and on inter-unit LAN communications. Devices shall be UL listed.

- a. The surge protection shall be a rugged package with continuous, non-interrupting protection and not use crowbar technology. Instant automatic reset after safely eliminating transient surges,

induced lightning, and other forms of transient overvoltages.

- b. Unit must react within 5 nanoseconds using only solid-state silicone avalanche technology.
- c. Unit shall be installed at the proper distance as recommended by the manufacturer.
- d. The unit shall have minimum 1 year full replacement warranty.

2.4.2.3 Sensor and Control Wiring Surge Protection

Controllers shall have sensor and control wiring surge protection with optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection. Devices shall be UL listed.

2.4.3 Wiring

Provide complete electric wiring for DDC System, including wiring to transformer primaries. Control circuit conductors which run in the same conduit as power circuit conductors shall have the same insulation level as power circuit conductors. Circuits operating at more than 100 Volts shall be in accordance with Section 16402, "Interior Distribution System." Circuits operating at 100 Volts or less shall be defined as low voltage and shall be run in rigid or flexible conduit, metallic tubing, metal raceways or wire trays, armored cable, or multiconductor cable. Use multiconductor cable for concealed accessible locations only. Provide circuit and wiring protection as required by NFPA 70. Aluminum-sheathed cable or aluminum conduit may be used but shall not be buried in concrete. Wiring in HVAC plenums shall be in conduit or rated for service in such plenums. Protect exposed wiring from abuse and damage.

2.4.3.1 AC Control Wiring

- a. Control wiring for 24 V circuits shall be insulated copper 18 AWG minimum and shall be rated for 300 VAC service.
- b. Wiring for 120 V shall be 14 AWG minimum and shall be rated for 600 V service.

2.4.3.2 Analog Signal Wiring

Analog signal wiring for analog inputs and analog outputs shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded, and have 20 AWG drain wire. Exception is direct connect RTD wiring which shall be a single 18 AWG minimum twisted pair, 100 percent shielded, and with 20 AWG drain wire. Each wire shall have insulation rated to 300 V ac.

Cables shall have an overall aluminum-polyester or tinned-copper (cable-shield tape), overall 20 AWG tinned copper cable drain wire, and overall cable insulation rated to 300 V ac. Install analog signal wiring in conduit separate from AC power circuits.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation under supervision of competent technicians regularly employed in the installation of DDC systems. Provide components for a complete and operational DDC system.

3.1.1 Wiring Criteria

- a. Input/output identification: Permanently label each field wire, cable, or pneumatic tube at each end with unique identification.
- b. Rigid or flexible conduit shall be terminated at all sensors and output devices.
- c. Surge Protection: Install surge protection as per manufacturers specifications.
- d. Grounding: Ground controllers and cabinets to a good earth ground. Ground controller to a ground in accordance with Section 16402, "Interior Distribution System." Grounding of the green ac ground wire, at the breaker panel, alone is not adequate. Run metal conduit from controller panels to adequate building grounds. Ground sensor drain wire shields at controller end.
- e. Contractor is responsible for correcting all associated ground loop problems.

3.1.1.1 Electrical Insulation of Field Device Signal Terminals

Electrically insulate signal circuit terminations on the field device to prevent electrical shorts from nearby power sources. Provide permanent plastic covers, clear silicone adhesive, etc.

3.1.2 Digital Controllers

- a. Do not divide control of a single mechanical system such as an air handling unit, boiler, chiller, or terminal equipment between two or more controllers. A single controller shall manage control functions for a single mechanical system. It is permissible, however, to manage more than one mechanical system with a single controller.
- b. Provide digital control cabinets that protect digital controller electronics from dust, at locations shown on the drawings. If not shown on drawings, assume at least one cabinet for the highest level LAN DDC. Each cabinet shall have separate 120 VAC duplex receptacle and separate 30 watt florescent light installed.
- c. Provide a main power switch at each highest level LAN digital controller within controller cabinet.
- d. No multiplexing of points is allowed.

3.1.3 Temperature Sensors

Provide temperature sensors in locations to sense the appropriate condition. Provide sensor where they are easy to access and service without special tools. Calibrate sensors to accuracy specified. In no case will sensors designed for one application be installed for another application.

3.1.3.1 Room Temperature Sensors

Provide on interior walls to sense average room temperature conditions. Avoid locations which may be covered by office furniture. Room temperature sensors should not be mounted on exterior walls when other locations are available. Mount center line of sensor at 5 feet above finished floor.

3.1.4 Damper Actuators

Actuators shall not be mounted in the air stream.

3.1.5 Control Drawings

- a. Post laminated copies of as-built control system drawings in each mechanical room.
- b. Provide 4 sets of as-built drawings to the activity.

3.2 ADJUSTMENTS

Calibrate instrumentation and controls and verify the specified accuracy using test equipment with a test equipment accuracy. Adjust controls and equipment to maintain conditions indicated, to perform functions indicated, and to operate in the sequence specified.

3.3 FIELD TESTS

3.3.1 General

- a. Demonstrate compliance of the heating, ventilating, and air conditioning control system with the contract documents. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that tests are performed by competent employees of the DDC system installer or the DDC system manufacturer regularly employed in the testing and calibration of DDC systems.
- b. Field tests shall demonstrate proper calibration of input and output devices, and the operation of specific equipment.
- c. Obtain approval of the plan for each phase of testing before beginning that phase of testing. Give to the Contracting Officer written notification of planned testing at least 45 days prior to test. Notification shall be accompanied by the proposed test procedures. In no case will the Contractor be allowed to start testing without written Government approval of test procedures.

The test procedures shall consist of detailed instructions for complete testing to prove performance of the heating, ventilating and air-conditioning system and digital control system. Test procedures shall include tests outlined in the following paragraphs.

- d. Furnish the field test documentation and written certification to the Contracting Officer that the installed system has been calibrated, tested, and is ready for the performance verification test.
- e. Tests are subject to oversight and approval by the Contracting Officer. The testing shall not be run during scheduled seasonal off-periods of heating and cooling systems.

3.3.2 Test Reporting for Field Testing

- a. Document all tests with detailed test results. Explain in detail the nature of each failure and corrective action taken.
- b. During and after completion of the Field Tests, identify, determine causes, replace, repair or calibrate equipment that fails to meet the specification, and deliver a written report to the Government.
- c. Provide a written report containing test documentation after the Field Tests. Convene a test review meeting at the job site to present the results to the Government. As part of this test review meeting, demonstrate by performing all portions of the field tests showing that each failure has been corrected. Based on the report and test review meeting, the Government will determine either the restart point or successful completion of testing. Do not commence retesting until after receipt of written notification by the Government. At the conclusion of retesting, assessment will be repeated.

3.3.3 Contractor's Field Testing

Calibrate field equipment and verify equipment and system operation before placing the system on-line. Field testing shall include the following tests:

3.3.3.1 System Inspection

Observe the HVAC system in its shutdown condition. Check dampers and valves for proper normal positions. Document each position for the test report.

3.3.3.2 Calibration Accuracy and Operation of Inputs Test

Check for proper calibration and operation of each input instrument. For each sensor (temperature), record the reading at the sensor, and using traceable test equipment, and record the reading at the digital controller. Document each reading for the test report.

3.3.3.3 Operation of Outputs Test

Check the operation of each output to verify correct operation. Command digital outputs on and off. Command analog outputs to minimum range, such as 4 mA, and maximum range, such as 20 mA, measure and record commanded and actual output values. Document each command and result for the test report.

3.3.3.4 Actuator Range Adjustment Test

With the digital controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position to full range of stroke position. Record actual spring ranges and normal positions for all modulating control valves and dampers. Include documentation in the test report.

3.3.3.5 Digital Controller Startup and Memory Test

Demonstrate that programming is not lost after a power failure, and digital controllers automatically resume proper control after a power failure.

3.3.3.6 Surge Protection Test

Show that surge protection, meeting the requirements of this specification, has been installed on incoming power to the digital controllers and on communications lines.

3.3.3.7 Application Software Operation Test

Test compliance of the application software for:

- a. Ability to communicate with the digital controllers, uploading and downloading of control programs
- b. Text editing program: Demonstrate the ability to edit the control program off line.
- c. Reporting of alarm conditions: Cause alarm conditions for each alarm, and ensure that workstation receives alarms.
- d. Reporting trend and status reports: Demonstrate ability of software to receive and save trend and status reports.

3.3.4 Performance Verification Tests

Conduct the performance verification tests to demonstrate control system maintains setpoints, control loops are tuned, and controllers are programmed for the correct sequence of operation. Conduct performance verification test during seven days of continuous HVAC and DDC systems operation and before final acceptance of work. Specifically the performance verification test shall demonstrate the following:

3.3.4.1 Execution of Sequence of Operation

Demonstrate the HVAC system operates properly through the complete sequence of operation, for example seasonal, occupied/unoccupied, and warm-up. Demonstrate proper control system response for abnormal conditions by simulating these conditions. Demonstrate hardware interlocks and safeties work. Demonstrate the control system performs the correct sequence of control after a loss of power.

3.3.4.2 Control Loop Stability and Accuracy

Furnish the Government graphed trends of control loops to demonstrate the control loop is stable and that setpoint is maintained. Control loop response shall respond to setpoint changes and stabilize in 3 minutes. Control loop trend data shall be real time and the time between data points shall not be greater than one minute. The contractor shall provide a printer, either the project printer or temporary, at the job site for printing graphed trends. The printer shall remain on the job site throughout Performance Verification Testing to allow printing trends.

3.4 TRAINING

Submit a training course materials, including schedule, syllabus, control drawings, instructor's qualifications, and training materials for approval 45 days prior to the start of training to the Contracting Officer. Furnish a qualified instructor who is certified by the DDC system manufacturer, is well versed in the specific system provided, with complete knowledge of the products installed, to conduct training courses for designated personnel in the maintenance and operation of the HVAC and DDC system. **The Government reserves the right to demand replacement of the instructor (without penalty) if the instructor fails to meet the above requirement**. Orient training to the specific system being installed under this contract. Use operation and maintenance manuals as the primary instructional aids in contractor provided activity personnel training. Base training on the Operations and Maintenance manuals and a DDC training manual. Manuals shall be delivered for each trainee with two additional sets delivered for archiving at the project site. Training manuals shall include an agenda, defined objectives and a detailed description of the subject matter for each lesson. Furnish audio-visual equipment and all other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15 minute breaks and excluding lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, the Contractor should assume the attendees will have a high school education and are familiar with HVAC systems.

3.4.1 DDC Training Phase I

The first class shall be taught for a period of 5 consecutive training days at least 1 month prior to the scheduled Performance Verification Test. The first course shall be taught in a conference room facility on base (by scheduling use of the one of the base conference rooms at least 8 weeks in advance; contractor being liable for payment up to \$150/week) or at the contractor's training facility providing such facility is dedicated solely to training operations and is within the local area. Training shall be classroom, but have hands-on operation of similar digital controllers. A

maximum of 5 personnel will attend this course. Upon completion of this course, each student, using appropriate documentation, should be able to perform elementary operations, with guidance, and describe the general hardware architecture and functionality of the system. This course shall include but not be limited to:

- a. Theory of operation
- b. Hardware architecture
- c. Operation of the system
- d. Operator commands
- e. Control sequence programming
- f. Data base entry
- g. Reports and logs
- h. Alarm reports
- i. Diagnostics

3.5 SEQUENCE OF OPERATION

See contract drawings for all sequence of operation requirements.

-- End of Section --

SECTION 15949

HVAC TESTING/ADJUSTING/BALANCING FOR SMALL SYSTEMS
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (1989) Testing and Balancing Heating,
Ventilating and Air Conditioning Systems

AABC TBP (1997) Test and Balance Procedures

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB TABES (1991) Testing, Adjusting, Balancing of
Environmental Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION,
INC. (SMACNA)

SMACNA HVACTAB (1993) HVAC Systems Testing, Adjusting and
Balancing

1.2 RELATED REQUIREMENTS

Perform work required by this section in accordance with the paragraph entitled "Subcontractor Special Requirements" in Section 01310, "Administrative Requirements."

Requirements for price breakdown of HVAC TAB work are specified in Section 01200, "Price and Payment Procedures."

Requirements for construction scheduling related to HVAC TAB work are specified in Section 01320, "Construction Progress Documentation".

1.3 DESCRIPTION OF WORK

The work includes test, adjust, and balance (TAB) of new heating, ventilating, and cooling (HVAC) air and water distribution systems including equipment, ducts, and piping which are located within, on, under, between, and adjacent to buildings.

1.3.1 Air Distribution Systems

Systems shall be tested, adjusted, and balanced (TAB'd) in compliance with

this section. Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems under Section 15080, "Mechanical Insulation."

1.4 DEFINITIONS

- a. TAB team supervisor: TAB team engineer.
- b. TAB team technician: TAB team assistant.
- c. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed.
- d. Field check group: One or more systems of the same basic type; the subgroup of a "field check group" is a "system."
- e. Out-of-tolerance data: Pertains only to field checking of certified DALT or TAB report. The term is defined as a measurement taken during field checking which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the certified DALT or TAB report for a specific parameter.
- f. Season of maximum heating load: Time of year when outdoor ambient temperature at equipment installation site remains within following range throughout the period of data recording for TAB work. Indicated winter outdoor design dry bulb temperature plus 30 to minus 30 degrees Fahrenheit.
- g. Season of maximum cooling load: Time of year when outdoor ambient temperature at equipment installation site remains within following range throughout the period of data recording for TAB work. Indicated summer outdoor design dry bulb temperature plus 15, minus 5 degrees Fahrenheit.

1.5 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-06 Test Reports

Certified TAB report; G

Submit certified reports in the specified format including the above data.

SD-07 Certificates

Design review report; G

Pre-field TAB engineering report; G

Advanced notice for TAB field work; G

1.6 TAB Submittal and Work Schedule

Compliance with the following schedule is the Contractor's responsibility.

- a. Design Review Report: Within 60 calendar days after the date of contract award, submit design review report.
- b. Pre-Field TAB Engineering Report: Within 120 calendar days after the date of contract award, submit the Pre-Field TAB Engineering Report.
- c. Advanced Notice For TAB Field Work: At a minimum of 60 calendar days prior to CCD, submit advance notice of commencement of TAB field work.
- d. TAB Field Work: At a minimum of 45 calendar days prior to CCD, and when the ambient temperature is within testing Season limits, accomplish TAB field work; submit certified TAB report; and conduct field check.
- e. Complete TAB Work: Prior to CCD, complete all TAB work.

1.7 QUALITY ASSURANCE

1.7.1 Modifications of References

Accomplish work in accordance with referenced publications of AABC or NEBB except as modified by this section. In the references referred to herein, consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may" wherever they appear. Interpret reference to the "authority having jurisdiction," the "Administrative Authority," the "Owner," or the "Design Engineer" to mean the "Contracting Officer."

1.7.2 Responsibilities

The Contractor shall be responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in paragraph entitled "TAB Submittal and Work Schedule."

1.7.2.1 Contractor

- a. Coordination of supporting personnel: Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the TAB field measurement work. Provide equipment mechanics to operate HVAC equipment to enable TAB field team to accomplish the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the TAB field work. Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the

controls check out.

- b. Deficiencies: Ensure that the TAB team leader submits all Design/Construction deficiency notifications directly to the Contracting officer within 3 days after the deficiency is encountered. Further, the Contractor shall ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.
- c. Prior to the TAB field team's commencement of work, ensure completion of the applicable inspections and work items listed in the TAB team leader's pre-field engineering report. List as prerequisite work items, the deficiencies, pointed out by the TAB team leader in the design review report.
- d. Do not allow the TAB team to commence TAB field work until all of the following work items are completed.

(1) Prerequisite HVAC work checkout list, specified in paragraph "Pre-final TAB Engineering Report", have been completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved prerequisite HVAC work checkout list.

- e. Advance notice: Furnish to the Contracting Officer with advance written notice for each event, the commencement of the TAB field work.
- f. Insulation work: Ensure that openings in duct and machinery insulation coverings, for TAB test ports, are marked, closed and sealed.

1.7.2.2 TAB Team Leader

- a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."
- b. Full time: Be present at the contract site when TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.
- c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.
- d. Support required: Specify the technical support personnel required from the Contractor other than the TAB team. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated.

- e. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.
- f. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.
- g. Certified TAB report: Certify the TAB report. This certification includes the following work:
 - (1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.
 - (2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.
- h. Design/Construction deficiencies: Within 3 working days after the TAB team has encountered any design or construction deficiencies, the TAB team leader shall submit written notification directly to the Contracting Officer, with a separate copy to the Contractor, of all such deficiencies.

Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency shall issue notice and request direction in the notification submittal.
- i. TAB Field Check: The TAB team leader shall attend and supervise TAB field check.

1.7.3 Certificates

1.7.3.1 Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

1.7.3.2 Pre-Field TAB Engineering Report

Submit report containing the following information:

- a. Step-by-step TAB procedure:
 - (1) Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.

(2) Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.

- b. Pre-field data: Submit AABC or NEBB or SMACNA HVACTAB data report forms with the following pre-field information filled in:

(1) Design data obtained from system drawings, specifications, and approved submittals.

(2) Notations detailing additional data to be obtained from the contract site by the TAB field team.

(3) Designate the actual data to be measured in the TAB field work.

(4) Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which instruments the choice will be made. The instrument key number shall be placed in the blank space where the measured data would be entered.

1.7.4 Test Reports

1.7.4.1 Certified TAB Reports

Submit Certified TAB Report in the following manner:

- a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB team leader. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.

- b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

(1) Data shall be measured and compiled on a continuous basis for the period in which TAB work affecting those rooms is being done.

(2) Data shall be measured/recorded only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode.

(3) Data may be compiled using direct digital controls trend logging where available. Otherwise, the Contractor shall temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls shall have been fully operational a minimum of 24 hours in advance of commencing data compilation. The specified data shall be included in the TAB Report.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 TAB PROCEDURES

3.1.1 TAB Field Work

Test, adjust, and balance the listed HVAC systems to the state of operation indicated on and specified in the contract design documents. Conduct TAB work, including maintenance and calibration of instruments, and measurement accuracy, in conformance with the AABC MN-1 and AABC TBP, or NEBB TABES, or SMACNA HVACTAB, except as supplemented and modified by this section. Provide instruments and consumables required to accomplish the TAB work. Air systems and water systems shall be proportionately balanced and reported in the certified TAB report.

3.1.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. Test ports required for testing by the TAB team leader shall be located in the field by the TAB team leader during TAB field work. It shall be the responsibility of the sheetmetal contractor to provide and install test ports as required by the TAB team leader.

3.1.3 TAB Air Distribution Systems

3.1.3.1 Split System Heat Pump

Split system heat pump including air handling unit, system fan, coils, ducts, plenums, mixing boxes, prefilters, terminal units and air distribution devices for supply air, return air and outside air.

3.1.3.2 Exhaust Fans

Exhaust fan systems including fans, ducts, plenums, grilles, and hoods for exhaust air.

3.1.4 TAB Work on Performance Tests Without Seasonal Limitations

3.1.4.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the heating systems and cooling systems.

3.1.4.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. That is, record these temperatures at beginning and at the end of data taking.

3.1.4.3 Refrigeration Units

For refrigeration compressors/condensers/condensing units, data as required by NEBB Form TAB 15-83, NEBB TABES shall be reported, including refrigeration operational data.

3.1.4.4 Coils

Heating and cooling performance capacity tests shall be reported for DX and electric coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports: the apparent coil capacity shall be determined by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; the calculations shall be submitted with the coil reports.

3.1.5 Workmanship

Conduct TAB work on specified HVAC systems until measured parameters are within plus or minus 10 percent of the design values, that is, the values specified or indicated on the contract documents.

3.1.6 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled "Workmanship," provide written notice as soon as possible to the Contractor and the Contracting Officer describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.2 DATA FROM TAB FIELD WORK

After completion of the TAB work, prepare a pre-final TAB report using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms shall be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship" of this section.

Prepare the report neatly and legibly; the pre-final TAB report shall be the final TAB report minus the TAB supervisor's review and certification. Obtain, at the contract site, the TAB supervisor's review and certification of the TAB report.

Verbally notify the Contracting Officer's TAB representative that the field check of the certified TAB report data can commence; give this verbal notice 48 hours in advance of when the field checking shall commence. Do not schedule field check of the certified TAB report until the specified workmanship requirements have been met or written approval of the deviations from the requirements have been received from the Contracting Officer.

3.3 QUALITY ASSURANCE FOR TAB FIELD WORK

3.3.1 Field Check

Test shall be made to demonstrate that capacities and general performance of air and water systems comply with the contract requirements.

3.3.1.1 Recheck

During field check, the Contractor shall recheck, in the presence of the Contracting Officer, random selections of data (water, air quantities, air motion, sound level readings) recorded in the certified report.

3.3.1.2 Areas Of Recheck

Points and areas of recheck shall be selected by the Contracting Officer.

3.3.1.3 Procedures

Measurement and test procedures shall be the same as approved for work for forming basis of the certified report.

3.3.1.4 Recheck Selections

Selections for recheck will not exceed 25 percent of the total number of reported data entries tabulated in the report.

3.3.2 Retests

If random tests reveals a measured quantity which is out-of-tolerance, the report is subject to disapproval at the Contracting Officers discretion. In the event the report is disapproved, all systems shall be readjusted and

tested, new data recorded, new certified reports submitted, and a new field check conducted at no additional cost to the Government.

3.3.3 Prerequisite for Approval

Compliance with the field checking requirements of this section is a prerequisite for the final approval of the certified TAB report submitted.

3.4 MARKING OF SETTINGS

Permanently mark the settings of HVAC adjustment devices including valves, splitters, and dampers, as applicable, so that adjustment can be restored if disturbed at any time. The permanent markings shall indicate the settings on the adjustment devices which result in the data reported on the submitted certified TAB report.

3.5 MARKING OF TEST PORTS

The TAB team shall permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, these markings shall be made on the exterior side of the duct insulation. The location of test ports shall be shown on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

-- End of Section --

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS
08/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2 (1997) National Electrical Safety Code

ANSI C57.12.28 (1988; Correction 1988) Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 709 (1992; R 1997) Laminated Thermosetting Material

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 100 (1996) Dictionary of Electrical and Electronics Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1993) Industrial Control and Systems Enclosures

NEMA MG 1 (1998; Errata 1999) Motors and Generators

NEMA MG 10 (1994) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors

NEMA MG 11 (1977; R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70

(1999) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 2, "Site Construction," Division 13, "Special Construction," and Division 15, "Mechanical". This section applies to all sections of Division 16, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 13.2 kV primary, three phase, three wire, 60 Hz, and 208Y/120 volts secondary, three phase, four wire. Final connections to the power distribution system at the existing oil switch shall be made by the Contractor as directed by the Contracting Officer.

1.5 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of Section 01330, "Submittal Procedures" and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

1.5.1 Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's

preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

1.5.2 Drawings

Submit drawings a minimum of 14 by 20 inches in size using a minimum scale of 1/8 inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.3 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

1.5.4 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

1.5.4.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.5.4.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.5 Operation and Maintenance Manuals

Comply with the requirements of Section 01781, "Operation and Maintenance Data" and the technical sections.

1.5.5.1 Operating Instructions

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

1.6 QUALITY ASSURANCE

1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.6.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.4 Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.5 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.6.6 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

1.6.7 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position.

Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square.

Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.9 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including pad-mounted transformers, having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to be in accordance with ANSI C57.12.28, such as for pad-mounted transformers, provide a self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

1.10 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each cable or wire located in manholes. Tag only new wire and cable provided by this contract. Tag legend shall be as indicated. The tags shall be polyethylene. Do not provide handwritten letters. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

1.10.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to ANSI C2, NFPA 70, and requirements specified herein.

1.11.1 Motors and Equipment

Provide motors, controllers, and contactors with their respective pieces of equipment. Motors, controllers, and contactors shall conform to Section 16402, "Interior Distribution System". Extended voltage range motors shall not be permitted. Control voltage for controllers and contactors shall not exceed 120 volts nominal. When motors and equipment furnished are larger

than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

1.11.2 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment under Section 16402, "Interior Distribution System." Power wiring and conduit shall conform to Section 16402, "Interior Distribution System." Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.11.3 High Efficiency Motors

1.11.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.11.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-10 of NEMA MG 1.

1.11.4 Three-Phase Motor Protection

Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

1.13 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 15, "Mechanical."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical sections.

3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09900, "Paints and Coatings".

3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.4 CABLE TAG INSTALLATION

Install cable tags in each manhole, as specified, including each splice. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes.

-- End of Section --

SECTION 16081

APPARATUS INSPECTION AND TESTING

09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Electrical Power Distribution Equipment and Systems
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1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods" applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-06 Test Reports

Acceptance tests and inspections; G

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

SD-07 Certificates

Qualifications of organization, and lead engineering technician; G

Acceptance test and inspections procedure; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled

"Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment.

The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

- a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.
- b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.4.2 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

- a. Section 16272, "Three-Phase Pad-Mounted Transformers"

b. Section 16303, "Underground Electrical Work"

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

SECTION 16272

THREE-PHASE PAD-MOUNTED TRANSFORMERS
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code
ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.7	(1993) Watthour Meter Sockets
ANSI C12.15	(1990) Electricity Metering Solid-State Demand Registers for Electromechanical Watthour Meters
ANSI C12.16	(1991) Electricity Metering Solid-State Electricity Meters
ANSI C37.47	(1981; Supp. 1983, Correction 1984, R 1992) Distribution Fuse Disconnecting Switches, Fuse Supports, and Current-Limiting Fuses
ANSI C57.12.22	(1993) Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers with High-Voltage Bushings, 2500 kVA and Smaller: High Voltage, 34 500 GrdY /19 920 Volts and Below; Low Voltage, 480 Volts and Below
ANSI C57.12.28	(1988; Correction 1988) Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM D 92	(1997) Flash and Fire Points by Cleveland Open Cup

ASTM D 117	(1996) Electrical Insulating Oils of Petroleum Origin
ASTM D 877	(1987; R 1995) Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D 1535	(1996) Specifying Color by the Munsell System
ASTM D 3455	(1995) Compatibility of Construction Material with Electrical Insulating Oil of Petroleum Origin
ASTM D 3487	(1988; R 1993) Mineral Insulating Oil Used in Electrical Apparatus

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825	(1999) Approval Guide
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
ANSI/IEEE C37.71	(1984; R 1990) Three-Phase, Manually Operated Subsurface Load-Interrupting Switches for Alternating-Current Systems
ANSI/IEEE C57.12.00	(1993) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.26	(1992) Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, (34 500 Grd Y/19 920 V and Below; 2500 kVA and Smaller)
ANSI/IEEE C57.12.80	(1978; R 1992) Terminology for Power and Distribution Transformers
ANSI/IEEE C57.12.90	(1993) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
ANSI/IEEE C57.13	(1993) Instrument Transformers

ANSI/IEEE C57.98 (1993) Guide for Transformer Impulse Tests

ANSI/IEEE C62.11 (1993) Metal-Oxide Surge Arresters for
Alternating Current Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LI 1 (1989) Industrial Laminated Thermosetting
Products

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (1999) Electrical Power Distribution
Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 467 (1993; R 1999) Grounding and Bonding
Equipment

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," and Section 16081, "Apparatus Inspection and Testing," apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

- a. Year 2000 compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures." As an exception to this paragraph, transformers manufactured by ABB in Jefferson City, MO; by Cooper Power Systems in Waukesha, WI; by GE in Shreveport, LA; or by Howard Industries in Laurel, MS need not meet the submittal requirements of this contract. Instead, the following shall be submitted:

- a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.
- b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings", item a).
- c. ANSI nameplate data of the transformer (paragraph entitled

"Pad-Mounted Transformer Drawings", item b).

- d. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses (paragraph entitled "Pad-Mounted Transformer Drawings", item e).
- e. Routine and other tests (paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and may be witnessed by the government (paragraph entitled "Source Quality Control"). Provide certified copies of the tests.
- f. Provide field test reports (paragraph entitled "Field Test Reports").
- g. Provide operation and maintenance manuals (paragraph entitled "Operation and Maintenance Manuals").

SD-02 Shop Drawings

Pad-mounted transformer drawings; G

SD-03 Product Data

Pad-mounted transformers; G

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

SD-06 Test Reports

acceptance checks and tests; G

Ground resistance test reports; G

Submit report of test results as specified by paragraph entitled "Field Quality Control"

SD-07 Certificates

Year 2000 (Y2K) Compliance Warranty; G

Transformer losses; G

SD-09 Manufacturer's Field Reports

Pad-mounted transformer design tests; G

Pad-mounted transformer routine and other tests; G

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5; G

Submit operation and maintenance data in accordance with Section

01781, "Operation and Maintenance Data" and as specified herein.

SD-11 Closeout Submittals

Transformer test schedule; G

1.5 QUALITY ASSURANCE

1.5.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

- a. An outline drawing, with front, top, and side views.
- b. ANSI nameplate data.
- c. Elementary diagrams and wiring diagrams with terminals identified of watt-hour meter and current transformers.
- d. One-line diagram, including switch(es), current transformers, meters, and fuses.
- e. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses.

1.5.2 Ground Resistance Test Reports

Upon completion and before energizing electrical equipment, submit the measured ground resistance of grounding system. When testing grounding electrodes and grounding systems, identify each grounding electrode and each grounding system for testing. Include the test method and test setup (i.e. pin locations) used to determine ground resistance and soil conditions at the time the measurements were made.

1.5.3 Transformer Losses

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses."

1.6 WARRANTY

1.6.1 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component", provide a statement of Y2K compliance warranty for the specific equipment. The contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations to the extent that other computer controlled component, used in combination with the computer controlled component being acquired, properly exchanges date and time data with it. If the contract requires that specific listed

products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be as defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provision to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

1.7 MAINTENANCE

1.7.1 Additions to Operation and Maintenance Manuals

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

- a. An instruction manual with pertinent items and information highlighted
- b. An outline drawing, front, top, and side views
- c. Prices for spare parts and supply list
- d. Routine and field acceptance test reports
- e. Fuse curves for primary fuses
- f. Information on watt-hour demand meter, CT's, and fuse block
- g. Actual nameplate diagram
- h. Date of purchase

PART 2 PRODUCTS

2.1 Y2K COMPATIBILITY

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, utility monitoring and control systems and other facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers.

2.2 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 16303, "Underground

Transmission and Distribution", and Section 16402, "Interior Distribution System".

2.3 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.26, ANSI C57.12.28 and as specified herein.

2.3.1 Compartments

The high- and low-voltage compartments shall be separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.3.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, six high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to oil-immersed fuses, dead-front surge arresters, tap changer handle, connector parking stands with insulated standoff bushings, protective caps, and ground pad.

- a. Insulated high-voltage load-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.
- b. Bushing well inserts: IEEE 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.
- c. Load-break switch

Loop feed sectionalizer switches: Provide three, two-position, oil-immersed type switches to permit closed transition loop feed and sectionalizing. Each switch shall be rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handles in the high-voltage compartment. Operation of switches shall be as follows:

ARRANGE- MENT NO.	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION						XFMR. SW	
		OPEN	CLOSE	OPEN	CLOSE	OPEN	CLOSE	OPEN	CLOSE
1	Line A connected to Line B and both lines connected to		X			X			X

ARRANGE- MENT NO.	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION							
		LINE A SW.		LINE B SW		XFMR. SW			
		OPEN	CLOSE	OPEN	CLOSE	OPEN	CLOSE	OPEN	CLOSE
	transformer								
2	Transformer connected to Line A only		X	X					X
3	Transformer connected to Line B only	X				X			X
4	Transformer open and loop closed		X			X		X	
5	Transformer open and loop open	X		X				X	

- d. Provide bayonet oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. Bayonet fuse links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Warning shall be conspicuously displayed within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.

Bayonet fuse assembly: 150 kV BIL.

Oil-immersed current-limiting fuses: ANSI C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.

- e. Surge arresters: ANSI/IEEE C62.11, rated 12 kV, fully shielded, dead-front, metal-oxide-varister, elbow type with resistance-graded gap, suitable for plugging into bushing well inserts. Provide three arresters for loop feed circuits.
- f. Parking stands: Provide a parking stand near each bushing well. Provide insulated standoff bushings for parking of energized load-break connectors on parking stands.

- g. Protective caps: IEEE 386, 200 amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushing well inserts and insulated standoff bushings.

2.3.1.2 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

- a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

- b. Metering: Provide a socket-mounted electronic programmable outdoor watthour meter, surface mounted flush against the side of the low-voltage compartment as indicated. Meter shall either be programmed at the factory or shall be programmed in the field. When field programming is performed, turn field programming device over to the Contracting Officer at completion of project. Meter shall be coordinated to system requirements and conform to ANSI C12.16.

(1) Design: Provide meter designed for use on a 3-phase, 4-wire, 208Y/120 volt system with 3 current transformers. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS) as specified in Section 15910, "Direct Digital Control Systems".

(2) Coordination: Provide meter coordinated with ratios of current transformers and transformer secondary voltage.

(3) Class: 20; Form: 9S; Accuracy: +/- 1.0 percent; Finish: Class II

(4) Cover: Polycarbonate and lockable to prevent tampering and unauthorized removal.

(5) Kilowatt-hour Register: 5 digit electronic programmable type

(6) Demand Register:

a) Provide solid state ANSI C12.15

b) Meter reading multiplier:

1) Indicate multiplier on the meter face.

c) Demand interval length: shall be programmed for 15 minutes with rolling demand up to six subintervals per interval.

(7) Meter fusing: Provide a fuse block mounted in the secondary compartment containing one fuse per phase to protect the voltage

input to the watthour meter. Size fuses as recommended by the meter manufacturer.

(8) Socket: ANSI C12.7. Provide NEMA Type 3R, box-mounted socket having automatic circuit-closing bypass and having jaws compatible with requirements of the meter. Cover unused hub openings with blank hub plates. Paint box Munsell 7GY3.29/1.5 green to match the pad-mounted transformer to which the box-mounted socket is attached. The Munsell color notation is specified in ASTM D 1535.

(9) Current transformers: ANSI/IEEE C57.13. Provide butyl-molded window type current transformers with 600-volt insulation, 10 kV BIL and mount on the low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters. Provide three current transformers per power transformer with characteristics listed in the following table.

<u>kVA</u>	<u>Sec. Volt</u>	<u>CT Ratio</u>	<u>RF</u>	<u>Meter Acc. Class</u>
75	208Y/120	200/5	4.0	0.3 thru B-0.1

2.3.2 Transformer

- a. Oil-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.
- b. Transformer shall be rated 75 kVA, 95 kV BIL.
- c. Transformer voltage ratings: 13.2 V - 208Y/120 V.
- d. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.
- e. Minimum tested impedance shall not be less than 2.45 percent at 85 degrees C.
- f. Audible sound levels shall comply with the following:

<u>kV</u>	<u>DECIBELS (MAX)</u>
75	51

- g. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure. The

transformer shall have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.3.2.1 Specified Transformer Losses

No-load losses (NLL) shall be 177 watts at 20 degrees C and load losses (LL) shall be 703 watts at 85 degrees C. The values for the specified losses shall be used for comparison with the losses determined during the routine tests. If the routine test values exceed the specified values by more than the tolerances allowed by Table 19 in ANSI/IEEE C57.12.00, the transformer is unacceptable.

2.3.3 Insulating Liquid

- a. Mineral oil: ASTM D 3487, Type II, tested in accordance with ASTM D 117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

2.3.4 Corrosion Protection

Bases and cabinets of transformers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A 167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 3 inches of concrete pad. Paint bases, cabinets, and tanks Munsell 7GY3.29/1.5 green. Paint coating system shall comply with ANSI C57.12.28 regardless of base, cabinet, and tank material. The Munsell color notation is specified in ASTM D 1535.

2.4 WARNING SIGNS

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

2.5 SOURCE QUALITY CONTROL

2.5.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

- (1) The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
- (2) The accuracy shall be directly traceable to the National Institute of Standards and Technology.
- (3) Instrument calibration frequency schedule shall not exceed 12

months for both test floor instruments and leased specialty equipment.

(4) Dated calibration labels shall be visible on all test equipment.

(5) Calibrating standard shall be of higher accuracy than that of the instrument tested.

(6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.5.2 Design Tests

ANSI/IEEE C57.12.00, and ANSI/IEEE C57.12.90. Section 5.1.2 in ANSI/IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for the specified transformer. Design tests shall have been performed prior to the award of this contract.

- a. Tests shall be certified and signed by a registered professional engineer.
- b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (OA), the same temperature rise rating, and the same insulating liquid as the transformer specified.
- c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include both the primary and secondary windings of that transformer.

(1) ANSI/IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and ANSI/IEEE C57.98.

(2) State test voltage levels.

(3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

- d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.26.
- e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

2.5.3 Routine and Other Tests

ANSI/IEEE C57.12.00. Routine and other tests shall be performed by the manufacturer on the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

- a. Cold resistance measurements (provide reference temperature)
- b. Phase relation
- c. Ratio
- d. No-load losses (NLL) and excitation current
- e. Load losses (LL) and impedance voltage
- f. Dielectric
 - (1) Impulse
- g. Leak

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to ANSI C2, NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and ANSI C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 16303, "Underground Electrical Work". Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression

connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 16303, "Underground Electrical Work".

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Meters and Current Transformers

ANSI C12.1.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. The top of the concrete slab shall be approximately 4 inches above the finished grade. Edges above grade shall have 1/2 inch chamfer. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant calking or sealant. Cut off and bush conduits 3 inches above slab surface. Concrete work shall be as specified in Section 03300, "Cast-In-Place Concrete."

3.5 FIELD QUALITY CONTROL

3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

- (1) Compare equipment nameplate information with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.
- (3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.
- (4) Verify correct liquid level in tanks.
- (5) Perform specific inspections and mechanical tests as recommended by manufacturer.
- (6) Verify correct equipment grounding.

b. Electrical tests

- (1) Perform insulation-resistance tests.
- (2) Perform turns-ratio tests.
- (3) Sample insulating liquid. Sample shall be laboratory tested for:
 - (a) Dielectric breakdown voltage
 - (b) Acid neutralization number
 - (c) Specific gravity
 - (d) Interfacial tension
 - (e) Color
 - (f) Visual condition
 - (g) Water content
 - (h) Power factor
- (4) Perform dissolved gas analysis (DGA).
- (5) Test for presence of PCB.

3.5.1.2 Current Transformers

a. Visual and mechanical inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.

- (2) Inspect physical and mechanical condition.
- (3) Verify correct connection of transformers with system requirements.
- (4) Verify that adequate clearances exist between primary and secondary circuit wiring.
- (5) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.
- (6) Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

- (1) Perform insulation-resistance test.
- (2) Perform a polarity test.
- (3) Perform a ratio-verification test.

3.5.1.3 Watthour Meter

a. Visual and mechanical inspection

- (1) Verify that meter type, scales, and connections are in accordance with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition. Examine for broken parts and shipping damage.
- (3) Verify tightness of electrical connections.

b. Electrical tests

- (1) Calibrate watthour meters according to manufacturer's published data.
- (2) Verify that correct multiplier has been placed on face of meter, where applicabl .

3.5.1.4 Grounding System

a. Visual and mechanical inspection

- (1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

- (1) Perform ground-impedance measurements utilizing the

fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 16303

UNDERGROUND ELECTRICAL WORK

02/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO HB	(1996) Highway Bridges
AASHTO M198	(1994) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 315	(1992) Details and Detailing of Concrete Reinforcement
ACI 318M/318RM	(1992) Building Code Requirements for Reinforced Concrete and Commentary

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS1	(1990) Impregnated Paper Insulated, Lead Covered Cable, Solid Type
AEIC CS5	(1994) Cross-linked Polyethylene Insulated Shielded Power Cable Rated 5 Through 46 kV
AEIC CS6	(1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69 kV

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code
ANSI C119.1	(1986; R 1997) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
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ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C 32	(1993) Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 139	(1999) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 260	(1998) Air-Entraining Admixtures for Concrete
ASTM C 309	(1998; Rev A) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections

FEDERAL SPECIFICATIONS (FS)

FS A-A-60005	(1998) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 48	(1996) Alternating-Current Cable Terminations 2.5 kV Through 765 kV
IEEE 404	(1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000-138,000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500-500,000 V

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(1998) Polyvinyl Chloride (PVC) Tubing and Conduit
NEMA TC 3	(1990) PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 9	(1990) Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation

NEMA WC 7 (1988; R 1991, Rev. 1991, 1992, and 1996)
Cross-Linked-Thermosetting-Polyethylene-
Insulated Wire and Cable for the
Transmission and Distribution of
Electrical Energy

NEMA WC 8 (1988; Rev. 1992 and 1996)
Ethylene-Propylene- Rubber-Insulated Wire
and Cable for the Transmission and
Distribution of Electrical Energy

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (1999) Electrical Power Distribution
Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 6 (1997; R 1999) Rigid Metal Conduit

UL 83 (1998; R 1999) Thermoplastic-Insulated
Wires and Cables

UL 467 (1993; R 1999) Grounding and Bonding
Equipment

UL 486A (1997; R 1998) Wire Connectors and
Soldering Lugs for Use with Copper
Conductors

UL 486B (1997; R 1997) Wire Connectors for Use
with Aluminum Conductors

UL 510 (1994; R 1998) Polyvinyl Chloride,
Polyethylene, and Rubber Insulating Tape

UL 514A (1996; R 1999) Metallic Outlet Boxes

UL 514B (1997; R 1998) Fittings for Cable and
Conduit

UL 651 (1995; R 1998) Schedule 40 and 80 Rigid
PVC Conduit

UL 651A (1995; R 1998) Type EB and A Rigid PVC
Conduit and HDPE Conduit

UL 854 (1996; Bul. 1997, R 1998) Service-Entrance
Cables

UL 1242

(1996; R 1998) Intermediate Metal Conduit

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods" and Section 16081, "Apparatus Inspection and Testing" apply to this section with additions and modifications specified herein.

1.2.1 Underground Service

Terminate underground service into building at a point 5 feet outside the building and projections thereof, except that service conductors shall be continuous to the interior terminating point indicated. Connections of the service to the service entrance equipment is included in Section 16402, "Interior Distribution System." Protect ends of underground conduit with threaded metal caps or plastic plugs as applicable until connections are made.

1.3 DEFINITIONS

- a. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.
- b. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.4 SUBMITTALS

Submit the following in accordance with the Section 01330, "Submittal Procedures."

SD-03 Product Data

Medium voltage cable; G

Medium voltage cable terminations; G

Medium voltage cable joints; G

SD-06 Test Reports

Arc-proofing test for cable fireproofing materials; G

Medium voltage cable qualification and production tests; G

Field Acceptance Checks and Tests; G

Identify each cable for 600-volt, and medium voltage cable tests. When testing grounding electrodes and grounding systems, identify each grounding electrode and each grounding system for testing. Include the test method and test setup (i.e. pin locations) used to determine ground resistance and soil conditions at the time the measurements were made.

SD-07 Certificates

Cable splicer/terminator; G

1.5 QUALITY ASSURANCE

1.5.1 Certificate of Competency for Cable Splicer/Terminator

Certification of the qualification of the cable splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made in medium voltage (5 kV to 35 kV) cables. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Conduit

2.1.1.1 Rigid Metal Conduit

UL 6, galvanized steel, threaded type.

2.1.1.2 Rigid Metal Conduit, PVC Coated

UL 6, galvanized steel, threaded type, coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2.1.1.3 Intermediate Metal Conduit

UL 1242, galvanized steel, threaded type.

2.1.1.4 Intermediate Metal Conduit, PVC Coated

UL 1242, galvanized steel, threaded type, coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils

thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2.1.1.5 Plastic Conduit for Direct Burial

NEMA TC 2 and UL 651, Type EPC-40-PVC.

2.1.1.6 Plastic Utilities Duct for Concrete Encasement

NEMA TC 6 and UL 651A, Type EB.

2.1.2 Fittings

2.1.2.1 PVC Conduit Fittings

NEMA TC 3, UL 514B, and UL 651.

2.1.2.2 PVC Duct Fittings

NEMA TC 9.

2.1.3 Conductors Rated 600 Volts and Less

Conductor sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted.

2.1.3.1 Conductor Types and Color Coding

Service entrance and direct buried conductors shall conform to UL 854, Type USE. Conductors in conduit other than service entrance shall conform to UL 83, Type THWN. Conductor size and number of conductors in each cable shall be as indicated. Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, or heat shrink type sleeves. Control circuit terminations shall be properly identified. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be stranded copper. All conductors shall be copper.

a. Colors for coding conductors shall be:

208-VOLT SYSTEM

Neutral - White

Phase A - Black

Phase B - Red

208-VOLT SYSTEM

Phase C - Blue

Grounding Conductor - Green

2.1.4 600 Volt Wire Connectors and Terminals

Shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on stranded conductors.

- a. For use with Copper Conductors: UL 486A.

2.1.5 600 Volt Splices

Provide splices with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply with ANSI C119.1.

- a. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package.
 - (1) Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold.
- b. Provide heavy wall heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied by a clean burning propane gas torch.
- c. Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as coverings or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.1.6 Medium Voltage Cable

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted.

2.1.6.1 Cable Configuration

Cable for 13.2 kV underground distribution system shall be Ozone resistant ethylene-propylene -rubber-insulated (EPR) cable conforming to NEMA WC 8. Cable shall be single conductor, employing concentric-lay-stranded, Class B, copper conductors. Cable shall have conductor and insulation shielding. Insulation shielding shall be metal tape type consisting of a concentric serving of tape according to NEMA WC 8. Cable shall be rated 15 kV with insulation and jacket thickness of 220 and 110 mils, respectively. Cable shall have a polyvinyl chloride jacket.

2.1.7 Medium Voltage Cable Terminations

IEEE 48 Class 1. Provide terminations including stress control terminator, ground clamp, connectors, and lugs. The terminator shall be the product of one manufacturer, suitable for the type and materials of the cable terminated. Furnish components in the form of a "UL listed" kit, including complete instructions which shall be followed for assembly and installation. Provide terminator as specified herein for terminating single conductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 35 KV indoor and outdoor. Do not use separate parts of copper or copper alloy in contact with aluminum or aluminum alloy parts in the construction or installation of the terminator.

2.1.7.1 Indoor Terminations/Terminations Within Equipment Enclosures

The indoor terminator shall be cold-shrink type or heat shrinkable type.

a. Cold-Shrink Type

Terminator shall be a one-piece design, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber, Munsel gray in color. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for the lugs). Termination shall be designed for installation in low or highly contaminated indoor and outdoor locations and shall be rated for continuous operation at 90 degree C, with an emergency overload temperature rating of 130 degree C.

b. Heat Shrinkable Type

Terminator shall consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking, resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition. Provide heat shrinkable sheds or skirts of the same material.

2.1.7.2 Termination; Separable Insulated Connector Type

Provide as specified in Section 16272, "Three-Phase Pad-Mounted Transformers".

2.1.8 Medium Voltage Cable Joints

Provide joints (splices) in accordance with IEEE 404 suitable for the rated voltage, insulation level, and insulation type of the cable. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion. Connectors shall be rated for voltage of 35 kV minimum.

- a. Heat-Shrinkable Joint: Consists of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating. waterproof mastic seal on both ends.
- b. Watertight Taped-Type Joint: Consists of an approved connector, self-fusing or self-bonding insulating tape, self-fusing semiconducting tape, tinned copper shielding tape or braid, and plastic tape.

2.1.9 Tape

2.1.9.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.1.9.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section 02315, "Excavation and Fill".

2.1.9.3 Fireproofing Tape

Furnish tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than 0.030 inch thick by 3 inches wide, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.1.10 Pull Rope

Shall be plastic having a minimum tensile strength of 200 pounds.

2.1.11 Grounding and Bonding Equipment

UL 467. Provide copper clad steel ground rods with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch in diameter. Ground rods shall be 10 feet long unless otherwise indicated.

2.1.12 Cable Tags

Provide as specified in 16050, "Basic Electrical Materials and Methods."

2.2 SOURCE QUALITY CONTROL

2.2.1 Arc-Proofing Test for Cable Fireproofing Materials

Manufacturer shall test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2-inch outside diameter, and a 0.125 inch thick wall, and covered with one-half lap layer of arc and fireproofing material per manufacturer's instructions. The arc and fireproofing tape shall withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode shall be obtained from a DC power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc shall be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly shall be tested at three unrelated points. Start time for tests shall be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time shall be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape shall indicate that the test has been performed and passed by the manufacturer.

2.2.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS6 qualification and production tests as applicable for each type of medium voltage cable.

PART 3 EXECUTION

3.1 INSTALLATION

Underground installation shall conform to ANSI C2 and NFPA 70 except as otherwise specified or indicated.

3.1.1 Contractor Damage

The Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the General Provisions of the contract. If the Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. Nonindicated utility lines found by the Contractor while scanning the construction site with electromagnetic or sonic tracing equipment will be treated as "indicated" utilities. In any event, the Contractor shall immediately notify the Contracting Officer of any such damage.

3.1.2 Concrete

Concrete work for electrical requirements shall be 3000 psi minimum ultimate 28-day compressive strength with 1 inch maximum aggregate conforming to the requirements of Section 03300, "Cast-in-Place Concrete."

3.1.3 Underground Conduit/Duct Without Concrete Encasement

The type of conduit shall be EPC-40-PVC, EPC-80-PVC, PVC-coated rigid metal conduit, PVC-coated intermediate metal conduit, rigid metal conduit, intermediate metal conduit, or rigid metal conduit field wrapped with 0.010 inch thick pressure-sensitive plastic tape applied with a 50 percent overlap.

3.1.3.1 Conduit Installation

The top of the conduit shall be not less than 24 inches below grade, and shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points. Run conduit in straight lines except where a change of direction is necessary. Terminate conduits in end-bells where they enter underground structures. As each conduit run is completed, draw a nonflexible testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. Provide not less than 3 inches clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve.

3.1.3.2 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. The concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads. Hydraulic jet method shall not be used.

3.1.3.3 Multiple Conduits

Separate multiple conduits by a minimum distance of 2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 3 inches. Stagger the joints of the conduits by rows and layers to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.1.4 Underground Duct with Concrete Encasement

Construct underground duct banks of individual conduits encased in concrete. Except where rigid galvanized steel conduit is indicated or

specified, the conduit shall be PVC, Type EB. Do not mix different kinds of conduit in any one duct bank. Ducts shall be a minimum of 4 inches in diameter unless otherwise indicated. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover around ducts. Separate conduits by a minimum concrete thickness of 2 inches, except separate light and power conduits from control, signal, and telephone conduits by a minimum concrete thickness of 3 inches.

3.1.4.1 Depth of Encasement

The top of the concrete envelope shall be a minimum of 18 inches below grade, except under roads and pavement, concrete envelope shall be a minimum of 24 inches below grade.

3.1.4.2 Slope of Encasement

Duct banks shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 3 inches in 100 feet. Except at conduit risers, changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet; sweep bends may be composed of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger. Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.

3.1.4.3 Conduit

Terminate conduits in end-bells where ducts enter underground structures. Stagger the joints of the conduits by rows and layers to strengthen the duct bank. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in duct bank. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of duct bank. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.

3.1.4.4 Test Mandrel

As each section of a duct bank is completed from structure to structure, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit shall be drawn through each conduit, after which a stiff-bristled brush, having the diameter of the conduit shall be drawn through until the conduit is clear of earth, sand, and gravel particles. Conduit plugs shall then be immediately installed.

3.1.4.5 Connections to Manholes

Duct bank envelopes connecting to underground structures shall be flared to have an enlarged cross-section at the manhole entrance to provide additional shear strength. The dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. The perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide for a positive interlock between the duct bank and the wall of the structure. Vibrators shall be used when this portion of the envelope is poured to assure a seal between the envelope and the wall of the structure.

3.1.4.6 Connections to Existing Underground Structures

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut the steel and bend out to tie into the reinforcing of the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.1.4.7 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 1 foot apart. Restrain reinforcing assembly from moving during concrete pouring.

3.1.5 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weep hole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.1.6 Underground Conduit for Service Feeders Into Buildings

Shall be PVC, Type EPC-40, galvanized rigid steel, or steel IMC from the service equipment to a point 5 feet beyond the building and projections thereof. Protect the ends of the conduit. Provide threaded metal caps or bushings for metal conduit, and coat the threads with graphite grease or other coating. Clean and plug conduit until conductors are installed. Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

3.1.7 Conduit Protection at Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) shall be PVC coated and shall extend from the first coupling or fitting

outside either side of the concrete (minimum of 6 inches from penetration).

3.1.8 Installation of Warning and Identification Tape

Provide warning tape for underground direct buried, in conduit, and concrete encased systems. Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.9 Underground Structure Construction

3.1.9.1 Grounding in Underground Structures

Provide a No. 1/0 AWG bare copper cable on each interior sidewall. The cables shall be exothermically welded to the ground rod in the structure, and shall be accessible for future grounding requirements.

3.1.10 Cable Pulling

Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, and other enclosures. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.1.10.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.1.10.2 Cable Pulling Tensions

Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

3.1.10.3 Installation of Cables in Underground Structures

Do not install cables utilizing the shortest path, but route along those walls providing the longest path and the maximum spare cable lengths. Form cables to closely parallel walls, without interference to duct entrances, and support on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

In existing manholes, handholes and vaults where new ducts are to be terminated or where new cables are to be installed, modify the existing installation of cables, cable supports and grounding as required for a uniform installation with cables carefully arranged and supported in the

same manner as specified for new cables.

3.1.10.4 Cable Markers (or Tags) in Underground Structures

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

3.1.11 600 Volt Cable Splicing and Terminating

Provide splices and terminations to protect 600 volt insulated power and lighting cables from accidental contact, deterioration of coverings and moisture. Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set. Make splices in underground distribution systems only in accessible locations such as manholes and handholes.

3.1.12 Medium Voltage Cable Terminations

Provide terminating devices and materials to protect medium voltage cable terminations from accidental contact, deterioration of coverings, and moisture. Make terminations by using materials and methods specified herein and as designated by the written instruction of the cable manufacturer and termination kit manufacturer. Termination for high-voltage cables shall be rated, and be capable of withstanding test voltages, in accordance with IEEE 48. Terminations of single- and multiconductor cables shall include the securing and sealing of the sheath and insulation of the cable conductors, stress relief and grounding of cable shields of shielded cable, and grounding of neutral conductors, metallic sheaths, and armor. Adequately support cables and cable terminations to avoid any excessive strain on the termination and the conductor connection.

3.1.13 Medium Voltage Cable Joints

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods specified herein and as designated by the written instructions of the cable manufacturer and the joint kit manufacturer. Size connectors properly for the cable being connected and crimp using a full circle compression tool.

3.1.13.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice.

Provide a bare copper ground connection brought out in a watertight manner and grounded to a ground rod as part of the splice installation. Ground conductors, connections, and rods shall be as specified elsewhere in this section. Wire shall be trained to the sides of the enclosure to prevent interference with the working area.

3.1.14 Fireproofing of Cables in Manholes, Handholes and Vaults

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in manholes, handholes, and vaults.

3.1.14.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.1.15 Grounding Systems

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

Pad-mounted transformers without protective fences	5 ohms
Ground in manholes, handholes, and vaults	5 ohms
Grounding other metal enclosures of primary voltage electrical and electrically-operated equipment	5 ohms
Grounded secondary distribution system neutral and noncurrent-carrying metal parts associated with distribution systems and grounds not otherwise covered	5 ohms

When work in addition to that indicated or specified is directed in order to obtain the specified ground resistance, the provisions of the contract covering "Changes" shall apply.

3.1.15.1 Grounding Electrodes

Provide cone pointed ground rods driven full depth plus 6 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.

3.1.15.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

- a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.
- b. Make compression connections using a hydraulic compression tool to

provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.15.3 Grounding Conductors

Grounding conductors shall be stranded-bare copper conforming to ASTM B 8, Class B, for sizes No. 6 AWG and larger, and shall be solid-bare copper conforming to ASTM B 1 for sizes No. 8 and smaller. Cable sheaths, cable shields, conduit, and equipment shall be grounded with No. 6 AWG.

3.1.15.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.1.16 Special Conditions

During the construction of duct banks and underground structures located in streets, the streets shall remain open to traffic. Plan and execute the work to meet this condition.

3.1.17 Excavating, Backfilling, and Compacting

Provide under this section as specified in Section 02315, "Excavation and Fill".

3.1.18 Reconditioning of Surfaces

3.1.18.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged with sod of equal quality to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.1.18.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement to the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.2 FIELD QUALITY CONTROL

3.2.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.2.1.1 600 Volt Cable Tests

Perform tests after wiring is completed, connected, and ready for operation, but prior to placing systems in service and before any branch circuit breakers are closed.

a. Visual and Mechanical Inspection

- (1) Inspect cables for physical damage and proper connection in accordance with contract plans and specifications.
- (2) Check cable color coding for compliance with contract specifications.

b. Electrical Tests

- (1) Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts DC for 1 minute. Minimum insulation - resistance values shall not be less than 50 megohms.
- (2) Perform continuity test to insure proper cable connection.

3.2.1.2 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment

a. Visual and Mechanical Inspection

- (1) Inspect exposed cable sections for physical damage.
- (2) Verify that cable supplied is in accordance with contract plans and specifications.
- (3) Inspect for proper shield grounding, cable support, and cable termination.
- (4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius.
- (5) Inspect for proper fireproofing.
- (6) If cables are terminated through window-type CT's, make an inspection to verify that neutrals and grounds are properly terminated for proper operation of protective devices.
- (7) Visually inspect jacket and insulation condition.

- (8) Inspect for proper phase identification and arrangement.

b. Electrical Tests

- (1) Perform a shield continuity test on each power cable by ohmmeter method; Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.
- (2) Perform a DC high-potential test on all cables. Adhere to precautions and limits as specified in the applicable NEMA/ICEA Standard for the specific cable. Test procedure shall be as follows, and the results for each cable test shall be recorded as specified herein. Field acceptance test voltage shall be as follows:

<u>CABLE RATING</u>	<u>DC TEST VOLTAGE</u>
15 kV	65 kV for cables without insulated connectors
15 kV	53 kV for cables with insulated connectors

- (a) Current-sensing circuits in test equipment shall measure only the leakage current associated with the cable under test and shall not include internal leakage of the test equipment.
- (b) Record wet- and dry-bulb temperatures or relative humidity and temperature.
- (c) Test each section of cable individually.
- (d) Individually test each conductor with all other conductors grounded; Ground all shields.
- (e) Terminations shall be properly corona-suppressed by guard ring, field reduction sphere, or other suitable methods as necessary.
- (f) Ensure that the maximum test voltage does not exceed the limits for terminators specified in IEEE Standard 48 or manufacturer's specifications.
- (g) Apply the DC high-potential test in at least five equal increments until maximum test voltage is reached. No increment shall exceed the voltage rating of the cable. Record DC leakage current at each step after a constant stabilization time consistent with system charging current.
- (h) Raise the conductor to the specified maximum test voltage and hold for fifteen (15) minutes. Record readings of leakage current at 30 seconds and one minute and at one-minute intervals thereafter. Provide a graphic plot of readings with leakage current (Y axis)

versus voltage (X axis) at each increment.

- (i) Reduce the conductor test potential to zero and measure residual voltage at discrete intervals.
- (j) Apply grounds for a time period adequate to drain all insulation stored charge.
- (k) When new cables are spliced into existing cables, the DC high-potential test shall be performed on the new cable prior to splicing. After test results are approved for new cable and the splice is completed, an insulation-resistance test and a shield-continuity test shall be performed on the length of new and existing cable including the splice. After a satisfactory insulation-resistance test, a DC high-potential test shall be performed on the completed cable system utilizing a test voltage 75% of new cable tested value.

3.2.1.3 Grounding System

a. Visual and mechanical inspection

- (1) Inspect ground system for compliance with contract plans and specifications

b. Electrical tests

- (1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test

3.2.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 16402

INTERIOR DISTRIBUTION SYSTEM

08/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.7	(1993) Watthour Meter Sockets
ANSI C12.15	(1990) Electricity Metering Solid-State Demand Registers for Electromechanical Watthour Meters
ANSI C12.16	(1991) Electricity Metering Solid-State Electricity Meters
ANSI C80.1	(1994) Rigid Steel Conduit - Zinc Coated
ANSI C80.3	(1994) Electrical Metallic Tubing - Zinc Coated
ANSI C80.5	(1994) Rigid Aluminum Conduit

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Electrical Power Distribution Equipment and Systems
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA BU 1	(1994) Busways
NEMA C12.1	(1995) Code for Electricity Metering

NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 4	(1993) Terminal Blocks
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA KS 1	(1996) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA MG 1	(1998; Errata 1999) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors
NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1998) Polyvinyl Chloride (PVC) Tubing and Conduit
NEMA TC 3	(1990) PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TC 14	(1984; R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
NEMA TP 1	(1996) Guide for Determining Energy Efficiency for Distribution Transformers
NEMA VE 1	(1996) Metal Cable Tray Systems
NEMA WD 1	(1999) Wiring Devices
NEMA WD 6	(1997) Wiring Devices - Dimensional Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 780 (1997) Lightning Protection Systems

UNDERWRITERS LABORATORIES INC. (UL)

UL 1 (1993; R 2000) Flexible Metal Conduit

UL 4 (1996; R 1998) Armored Cable

UL 5 (1996; R 1998) Surface Metal Raceways and Fittings

UL 5A (1999) Nonmetallic Surface Raceways and Fittings

UL 6 (1997; R 1999) Rigid Metal Conduit

UL 20 (1995; R 1998) General-Use Snap Switches

UL 44 (1999) Thermoset-Insulated Wires and Cables

UL 50 (1995; R 1999) Safety Enclosures for Electrical Equipment

UL 67 (1993; R 2000) Panelboards

UL 83 (1998; R 1999) Thermoplastic-Insulated Wires and Cables

UL 198C (1986; Bul. 1991, 1992, 1993, 1994, and 1996, R 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types

UL 198E (1988; R 1988, Bul. 1993 and 1994) Class R Fuses

UL 198H (1988; Bul. 1993 and 1994, R 1993) Class T Fuses

UL 360 (1996; R 1997) Liquid-Tight Flexible Steel Conduit

UL 467 (1993; R 1999) Grounding and Bonding Equipment

UL 486A (1997; R 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 486B (1997; R 1997) Wire Connectors for Use with Aluminum Conductors

UL 486C	(1997; R 1998) Splicing Wire Connectors
UL 489	(1996; R 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(1996; R 1999) Attachment Plugs and Receptacles
UL 506	(1994; R 1997, Bul. 1997) Specialty Transformers
UL 508	(1999; R 1999) Industrial Control Equipment
UL 510	(1994; R 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; R 1999) Metallic Outlet Boxes
UL 514B	(1997; R 1998) Fittings for Cable and Conduit
UL 514C	(1996; R 2000) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 719	(1996; R 1999) Nonmetallic-Sheathed Cable
UL 797	(1993; R 1997) Electrical Metallic Tubing
UL 845	(1995; R 1999) Motor Control Centers
UL 854	(1996; Bul. 1997, R 1998) Service-Entrance Cables
UL 857	(1994; R 1999) Busways and Associated Fittings
UL 869A	(1998) Service Equipment
UL 870	(1995; R 1999) Wireways, Auxiliary Gutters, and Associated Fittings
UL 886	(1994; R 1999) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 943	(1993; R 1998) Ground-Fault Circuit-Interrupters
UL 984	(1996) Hermetic Refrigerant Motor-Compressors
UL 1010	(1995; R 1999) Receptacle-Plug Combinations for Use in Hazardous

(Classified) Locations

UL 1242	(1996; R 1998) Intermediate Metal Conduit
UL 1449	(1996; R 2000) Transient Voltage Surge Suppressors
UL 1561	(1999) Dry-Type General Purpose and Power Transformers
UL 1569	(1999; R 2000) Metal-Clad Cables
UL 1660	(2000) Liquid-Tight Flexible Nonmetallic Conduit

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein.

1.3 DEFINITIONS

- a. Year 2000 compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Panelboards; G

SD-03 Product Data

Receptacles; G

Circuit breakers; G

Switches; G

Motor controllers; G

Manual motor starters; G

SD-06 Test Reports

600-volt wiring test; G

Grounding system test; G

Ground-fault receptacle test; G

SD-07 Certificates

Fuses; G

Year 2000 (Y2K) Compliance Warranty; G

1.5 QUALITY ASSURANCE

1.5.1 Fuses

Submit coordination data as specified in article entitled, "FUSES" of this section.

1.6 WARRANTY

1.6.1 Year 2000 (Y2K) Compliance Warranty

For each product, component, and system specified in this section as a "computer controlled facility component," provide a statement of Y2K compliance warranty for the specific equipment. The Contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the Years 1999 and 2000 and leap year calculations to the extent that other computer controlled component, used in combination with the computer controlled component being acquired, properly exchanges date and time data with it. If the contract requires that specific listed products shall perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be as defined in, and subject to, the terms and limitations of the Contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provision to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the Contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

PART 2 PRODUCTS

2.1 Y2K COMPATIBILITY

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, HVAC controllers,

utility monitoring and control systems, alarms, and other facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers.

2.2 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.3 CONDUIT AND FITTINGS

Shall conform to the following:

2.3.1 Rigid Metallic Conduit

2.3.1.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1, UL 6.

2.3.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, in accordance with NEMA TC 2, or fiberglass conduit, in accordance with NEMA TC 14.

2.3.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.3.4 Electrical Metallic Tubing (EMT)

UL 797, ANSI C80.3.

2.3.5 Plastic-Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40 (40 mils thick).

2.3.6 Flexible Metal Conduit

UL 1.

2.3.6.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.3.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.3.7.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.3.7.2 Fittings for EMT

Steel compression type.

2.3.7.3 Fittings for Use in Hazardous (Classified) Locations

UL 886.

2.3.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3.

2.4 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal.

2.5 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.6 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.6.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.6.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.6.1.2 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.6.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit

conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, three-phase

- (1) Phase A - black
- (2) Phase B - red
- (3) Phase C - blue

2.6.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83 conforming to UL 44, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.6.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.7 SPLICES AND TERMINATION COMPONENTS

UL 486A for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.8 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.03 inch thick. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.9 SWITCHES

2.9.1 Toggle Switches

NEMA WD 1, No. 1121 for single pole, No. 1122 for double pole, No. 1123 for three-way, and No. 1124 for four-way, totally enclosed with bodies of

thermosetting plastic and mounting strap with grounding screw. Handles shall be brown. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.9.2 Switch with Red Pilot Handle

NEMA WD 1. Provide pilot lights that are integrally constructed as a part of the switch's handle. The pilot light shall be red and shall illuminate whenever the switch is closed or "on". The pilot lighted switch shall be rated 20 amps and 120 volts or 277 volts as indicated. Provide the circuit's neutral conductor to each switch with a pilot light.

2.9.3 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 1 for interior locations and NEMA 3R enclosure for outdoor locations as indicated per NEMA ICS 6.

2.10 RECEPTACLES

UL 498 and NEMA WD 1, general grade, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of brown thermosetting plastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap.

2.10.1 Duplex Receptacles

Duplex receptacles shall be 20 amperes, 125 volts, No. 5342.

2.10.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."

2.10.3 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFI devices.

2.10.4 Special Purpose Receptacles

Provide in ratings indicated.

2.11 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as indicated.

Panelboards for use as service disconnecting means shall additionally conform to UL 869A. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted "above" or "below" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served from Panel MDP). Type directories and mount in holder behind transparent protective covering.

2.11.1 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.11.2 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.11.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.11.2.2 Circuit Breakers for HVAC Equipment

Circuit breakers for HVAC equipment having motors (group or individual) shall be marked for use with HACR type and UL listed as HACR type.

2.12 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.12.1 Cartridge Fuses, Current Limiting Type (Class R)

UL 198E, Class RK-5 time delay-type. Associated fuseholders shall be Class R only.

2.13 MOTORS

NEMA MG 1; hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.

2.13.1 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.14 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is

in "off" position. Minimum short circuit withstand rating of combination motor controller shall be 10,000 rms symmetrical amperes.

2.14.1 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. One secondary lead shall be fused; other shall be grounded.

2.14.2 Enclosures for Motor Controllers

NEMA ICS 6.

2.14.3 Terminal Blocks

NEMA ICS 4.

2.15 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single pole designed for flush mounting with overload protection.

2.16 TELEPHONE SYSTEM

Provide system of telephone wire-supporting structures, including: conduits with pull wires, terminal boxes, outlet and junction boxes, other accessories for telephone outlets, and backboards.

2.16.1 Outlet Boxes for Telephone System

Outlet boxes for wall-mounted telephones shall be 2 by 4 by 2 1/8 inches deep; mounted at height as indicated.

2.16.2 Cover Plates

Modular telephone type with same finish specified for receptacle and switch cover plates.

2.16.3 Conduit Sizing

Conduit for single outlets shall be minimum of 3/4 inch and for multiple outlets minimum of one inch. Size conduits for telephone risers to telephone cabinets, junction boxes, distribution centers, and telephone service, as indicated.

2.16.4 Backboards

Interior grade plywood, 3/4 inch thick, size as indicated. Paint with gray fire resistant paint.

2.16.5 Receptacles for Telephone Service

Provide receptacles, 125 volts, 20 amperes, single phase, 60 Hz, adjacent to telephone backboards, served from panelboard circuit as indicated.

2.17 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.18 NAMEPLATES

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Service Entrance Identification

Service entrance disconnect devices, and enclosures shall be labeled and identified as such.

3.1.2.1 Labels

Provide laminated plastic labels conforming to paragraph entitled "Nameplates." Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits.

3.1.3.1 Restrictions Applicable to EMT

- a. Do not install underground.
- b. Do not encase in concrete, mortar, grout, or other cementitious materials.

- c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.
- d. Do not use outdoors.

3.1.3.2 Nonmetallic Conduit

- a. Restrictions applicable to PVC Schedule 40 and PVC Schedule 80
 - (1) Do not use above finish floor.

3.1.3.3 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph entitled "Flexible Connections."

3.1.3.4 Service Entrance Conduit, Underground

PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.3.5 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40. Convert nonmetallic conduit, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 inches above floor.

3.1.3.6 Conduit in Floor Slabs

PVC, Type EPC-40, unless indicated otherwise.

3.1.4 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.4.1 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.4.2 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.4.3 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 1/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.

3.1.4.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.5 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-pound tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.4.6 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.7 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches

above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.1.5 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, and when specifically indicated. Boxes in other locations shall be sheet steel. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports, or make adequate provisions for distributing load over ceiling support members in an approved manner. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.1.5.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Telephone outlets shall be minimum of 4 inches square by 2 1/8 deep, except for wall mounted telephones.

3.1.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6 Mounting Heights

Mount panelboards, circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches, receptacles and other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.7 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with Section 15910, "Direct Digital Control Systems".

3.1.8 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.10 Grounding and Bonding

In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic raceways, telephone system grounds, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Interconnect all grounding media in or on the structure to provide a common ground potential. This shall include electrical service, telephone system grounds, as well as underground metallic piping systems.

3.1.10.1 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms

under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.10.2 Telephone Service

Provide main telephone service equipment ground consisting of separate ground wire, No. 6 AWG, in conduit between equipment backboard and readily accessible grounding connection. Equipment end of ground wire shall consist of coiled length at least twice as long as terminal cabinet or backboard height.

3.1.11 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.12 Government-Furnished Equipment

Contractor shall make connections to Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.13 Repair of Existing Work

3.1.13.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 Ground-Fault Receptacle Test

Test GFI receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.2.4 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --

SECTION 16510

INTERIOR LIGHTING
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C62.11	(1993) Metal-Oxide Surge Arresters for Alternating Current Power Circuits
ANSI C78.41	(1995) Electric Lamps - Low-Pressure Sodium Lamps
ANSI C78.42	(1995) Electric Lamps - Guideline for High-Pressure Sodium Lamps
ANSI C78.1375	(1996) Electric Lamps - 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1996) Electric Lamps - 1000-Watt, M47 Single-Ended Metal-Halide Lamps
ANSI C78.1377	(1996) Electric Lamps - 175-Watt, M57 Single-Ended Metal-Halide Lamps
ANSI C78.1378	(1996) Electric Lamps - 250-Watt M58 Single-Ended Metal-Halide Lamps
ANSI C78.1381	(1989; R 1997) Electric Lamps - 70-Watt M85 Metal-Halide Lamps
ANSI C78.1382	(1996) Electric Lamps - 100-Watt M90 Single-Ended Metal-Halide Lamps
ANSI C78.1384	(1997) Electric Lamps - 150-Watt M102 Single-Ended Metal-Halide Lamps
ANSI C82.1	(1997) Electric Lamp Ballast - Line Frequency Fluorescent Lamp Ballast
ANSI C82.2	(1984; R 1995) Fluorescent Lamp Ballasts - Methods of Measurement
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure

Sodium Lamps (Multiple-Supply Type)

ANSI C82.11 (1993; R 1998) High-Frequency Fluorescent Lamp Ballasts

ANSI C136.10 (1996) Roadway Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M (1997) Commercial Quality (CS) Steel, Carbon, (0.15 Maximum Percent) Cold-Rolled

ASTM A 580/A 580M (1998; Rev. A) Stainless Steel Wire

ASTM A 641/A 641M (1998) Zinc-Coated (Galvanized) Carbon Steel Wire

ASTM A 653/A 653M (1999; Rev A) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B 633 (1998) Electrodeposited Coatings of Zinc on Iron and Steel

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES LHBK (1993) Lighting Handbook, Reference and Application

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2 (1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC

NEMA ICS 6 (1993) Industrial Control and Systems Enclosures

NEMA LL 1 (1997) Procedures for Linear Fluorescent Lamp Sample Preparation and the TCLP

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 90A (1999) Installation of Air Conditioning and Ventilating Systems

NFPA 101 (1997) Life Safety Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 20	(1995; R 1998) General-Use Snap Switches
UL 595	(1985; R 1991, Bul. 1994, and 1996) Marine-Type Electric Lighting Fixtures
UL 773	(1995; R 1998) Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 773A	(1995; R 1998) Nonindustrial Photoelectric Switches for Lighting Control
UL 844	(1995; R 1999) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 924	(1995; R 1997, Bul. 1998) Emergency Lighting and Power Equipment
UL 935	(1995; R 1998) Fluorescent-Lamp Ballasts
UL 1029	(1994; R 1997) High-Intensity-Discharge Lamp Ballasts
UL 1570	(1995; R 1999) Fluorescent Lighting Fixtures
UL 1571	(1995; R 1999) Incandescent Lighting Fixtures
UL 1572	(1995; R 1999) High Intensity Discharge Lighting Fixtures

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16402, "Interior Distribution System." Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

1.3 DEFINITIONS

1.3.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.3.2 Total Harmonic Distortion (THD)

The root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures." Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES LHBK, as applicable, for the lighting system specified.

SD-03 Product Data

Fluorescent lighting fixtures; G

Fluorescent electronic ballasts; G

Fluorescent lamps; G

High-intensity-discharge (HID) lighting fixtures; G

HID ballasts; G

High-pressure sodium (HPS) lamps; G

Time switch; G

Emergency lighting equipment; G

SD-06 Test Reports

Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

SD-11 Closeout Submittals

Information card; G

1.5 QUALITY ASSURANCE

1.5.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. This information shall include published specifications and sketches, which covers the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, and shall contain a list of vendors with vendor part numbers.

1.5.2 Lighting Fixtures, Complete With Lamps and Ballasts

Submit one sample of each fixture type and large order item for inspection, review, and approval. The sample shall be retained for comparison against

the remainder of the fixtures. The sample may be used in the final fixture installation.

1.5.3 Information Card

For each electronic ballast manufacturer used in the construction, furnish a typewritten card, laminated in plastic. Card shall be 8 1/2 by 11 inches minimum and shall contain the information listed on Form 1 located at the end of this section. The card shall be turned over to the officer in charge of construction with warranty and equipment information. Send a photostatic paper copy to Engineering Field Activity Chesapeake, Code 18, 901 M Street SE, Building 212, Washington Navy Yard, Washington, DC 20374-5018.

1.6 ELECTRONIC BALLAST WARRANTY

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1570. Fluorescent fixtures shall have electronic ballasts unless specifically indicated otherwise.

2.1.1 Fluorescent Lamp Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

- a. Ballast shall comply with UL 935, ANSI C82.11, and NFPA 70 unless specified otherwise. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.
- b. Power factor shall be 0.95 (minimum).
- c. Ballast shall operate at a frequency of 20,000 Hertz (minimum).
- d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.
- e. Ballast shall be UL listed Class P with a sound rating of "A."

- f. Ballast enclosure size shall conform to standards of electromagnetic ballasts. Ballast shall have circuit diagrams and lamp connections displayed on ballast packages. Ballast shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed.
- g. Ballast shall operate in an instant start mode.
- h. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.1.1.1 T-8 Lamp Ballast

- a. Ballast shall be capable of starting and maintaining operation at a minimum of 50 degrees F for F32T8 lamps, unless otherwise indicated. When indicated, ballast shall be capable of starting and maintaining operation at a minimum of zero degrees F for F32T8 lamps.
- b. Total harmonic distortion (THD): Shall be 20 percent (maximum).
- c. Input wattage.
 - (1) 62 watts (maximum) when operating two F32T8 lamps
 - (2) 92 watts (maximum) when operating three F32T8 lamps
 - (3) 114 watts (maximum) when operating four F32T8 lamps
- d. Provide three and four lamp fixtures with two ballasts per fixture where multilevel switching is indicated.

2.1.1.2 F17T8 Lamp Ballast

- a. Ballast shall be capable of starting maintaining operation at a minimum of 50 degrees F for F17T8 lamps, unless otherwise indicated.
- b. Total harmonic distortion (THD): Shall be 25 percent (maximum).
- c. Input wattage:
 - (1) 34 watts (maximum) when operating two F17T8 lamps.

2.1.2 Fluorescent Lamps

- a. T-8 rapid start lamps shall be rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours. Low mercury lamps shall have passed the EPA Toxicity Characteristic Leading Procedure (TCLP) for mercury by using the lamp sample preparation

procedure described in NEMA LL 1.

- b. T-8 rapid start lamp, 17 watt (maximum), nominal length of 24 inches, 1300 initial lumens, CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours.
- c. Compact fluorescent lamps shall be: CRI 80, minimum, 3500 K, 10,000 hours average rated life, and as follows:
 - (1) T-4, twin tube, rated 7 watts, 400 initial lumens (minimum).

Average rated life is based on 3 hours operating per start.

2.1.3 Compact Fluorescent Fixtures

Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Providing assemblies designed to retrofit incandescent fixtures is prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall use lamps as indicated.

2.1.4 Open-Tube Fluorescent Fixtures

Provide with self-locking sockets, or lamp retainers (two per lamp).

2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

UL 1572.

2.2.1 HID Ballasts

UL 1029 and ANSI C82.4 and shall be constant wattage autotransformer (CWA) or regulator, high power factor type. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

- a. Designed to operate on the voltage system to which they are connected.
- b. Designed for installation in a normal ambient temperature of 40 degrees C.
- c. Constructed so that open circuit operation will not reduce the average life.

High-pressure sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode.

2.2.2 High-Pressure Sodium (HPS) Lamps

ANSI C78.42 wattage as indicated.

2.3 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom. Access to ballast shall be from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as indicated.

2.4 TIME SWITCH

Astronomic dial type or electronic type, arranged to turn "ON" at sunset and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch rated 120 volts, having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 15 hours following power failure. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface-mounted, NEMA 1 enclosure conforming to NEMA ICS 6.

2.5 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101. Provide lamps in wattage indicated.

2.5.1 Emergency Lighting Unit

Provide as indicated. Equip units with brown-out sensitive circuit to activate battery when ac input falls to 75 percent of normal voltage.

2.6 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

2.6.1 Wires

ASTM A 641/A 641M, Class 3, soft temper, zinc-coated finish, 0.1055 inches in diameter (12 gage).

PART 3 EXECUTION

3.1 INSTALLATION

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed fixtures may be supported from suspended ceiling support system ceiling tees when the ceiling system support wires are provided at a minimum of four wires per fixture and located not more than 6 inches from each corner of each fixture. For recessed fixtures, provide support clips securely fastened to ceiling grid members, a minimum of one at or near each corner of each fixture. For round fixtures or fixtures smaller in size than the ceiling grid, provide a minimum of four wires per fixture and locate at each corner of the ceiling grid in which the fixture is located. Do not support

fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently or with at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees. Provide wires for lighting fixture support in this section.

3.1.1 Emergency Lighting Units

Wire emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

FORM 1, ELECTRONIC BALLAST WARRANTY

1. Location _____ 2. Bldg. Name _____
3. Bldg. No. _____ 4. Installation Areas _____
5. Contract No. _____
6. Ballast Manufacturer Name/Address _____
7. Exchange Information _____
8. Warranty Return Number: _____
9. Warranty Period: From _____ To _____
10. Acceptance Date: _____ 11. Inspector: _____
12. Prime Contractor Name/Address: _____
Signature: _____ Date: _____

INSTRUCTIONS FOR FORM 1

1. Location: Name of activity as shown on contract.
2. Bldg. Name: As shown on contract or as provided by Contracting Officer.
3. Bldg. No.: As provided by Contracting Officer.
4. Installation Areas: Main areas in the building where ballasts are installed; floors, room numbers, lean-to, etc. A separate form is required for each ballast manufacturer used in the contract.
5. Contract No.: As shown on the contract.
6. Ballast Manufacturer Name/Address: Ballast manufacturer's name, address, and telephone number.
7. Exchange Information: Ballast exchange information such as point of contact, telephone number, shipping address if different from item 6, and any special shipping instructions.
8. Warranty Return Number: Return authorization number if required.
9. Warranty Period: Insert estimated start and end dates.
10. Acceptance Date: Show date ballasts were accepted by the Contracting Officer.
11. Inspector: Show Government inspector's name.
12. Prime Contractor Name/Address/Signature/Date: Shall be signed and dated by an official of the contracting firm.

-- End of Section --

SECTION 16822

INTERCOMMUNICATION SYSTEM
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.2 (ASA 85) (1989; R 1995) Measuring the
Intelligibility of Speech Over
Communication Systems

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC
Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 6 (1997; R 1999) Rigid Metal Conduit

UL 50 (1995; R 1999) Safety Enclosures for
Electrical Equipment

UL 797 (1993; R 1997) Electrical Metallic Tubing

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Year 2000 compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SYSTEM DESCRIPTION

1.4.1 Performance Requirement for Type 1 System

Solid state, modular in design, and shall be of the wired type with a single master with two remote stations. The master station shall be capable of control two doors thru two buttons and electric strike release.

1.4.1.1 Sound Reproduction

The intercommunication system shall reproduce at all receiving stations a 30 dB dynamic range of a 40 dB minimum input signal referenced to sound pressure level (SPL) over the frequency range of 300 to 3300 Hz. Unless otherwise specified, SPL shall be 20 micro Pascal (0.00002 Newtons per square meter). The root-mean square (rms) extraneous noise (e.g. hum) level introduced by the intercommunication system shall be at least 30 dB below the nominal signal level. Distortion, including envelope delay, intermodulation, cross talk, and other nonlinear source, shall not exceed 5 percent.

1.4.1.2 System Performance

Provide system with normally acceptable speech intelligibility, defined as a score of at least 75 percent obtained utilizing the phonetically balanced monosyllabic word intelligibility test in accordance with ANSI S3.2 (ASA 85).

1.4.1.3 System Operation and Service Features

- a. Provide the system with a power switch and an associated pilot light for ON and OFF operations. Include a volume switch at each station to regulate listening volume. Unless otherwise specified, the system shall operate on 120 Vac, single phase, 60 Hz source.
- b. All master stations shall have a "call-in" switch to provide an audible and visual indication of incoming calls from remote station. Individual visual indication shall identify calling station and status, and remain actuated until a call is answered by a master station.
- c. In addition to the manufacturer's standard identification plates, provide engraved laminated phenolic identification plates for each component connection and terminal identification labels, and shall be 3-layer black on white on black, engraved to show white letters on black background. Warning or caution labels shall be 3-layers red on white on red, engrave to show white letters on red background. Control switches and knobs shall be clearly marked with their function and status. Identification strips for station selector switches shall be located to clearly identify remote and master stations and shall be protected by transparent plastic inserts. Lettering shall be a minimum of 1/4 inch high, normal block style.
- d. At speaker/handset stations, lifting the handset shall automatically cut out the loudspeaker in the station and all conversation shall be carried through handset.
- e. A privacy switch shall be provided at each remote station. In the

ON position, the switch shall prevent any transmission of sound from the remote station. When in the OFF position, without further switch manipulation, the station shall respond to incoming calls upon voice activation from anywhere within 20 footradius of station.

- f. The master station shall have a pushbutton for each remote door release.

1.5 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Intercommunication system

Submit for overall system and for each major component. Illustrate how each item of equipment will function in the system and include an overall system schematic indicating relationship of intercommunication units on one diagram identifying type, size, and number of wiring, conduits and each major component.

SD-03 Product Data

Materials and equipment for Type 1 system

Cables and raceways

Surge protection

SD-07 Certificates

Year 2000 (Y2K) Compliance Warranty

SD-10 Operation and Maintenance Data

Intercommunication system, Data Package 5

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

1.6 WARRANTY

1.6.1 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component" provide a statement of Y2K compliance warranty for the specific equipment. The contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first

centuries, and the years 1999 and 2000 and leap year calculations to the extent that other computer controlled components, used in combination with the computer controlled component being acquired, properly exchange data and time data with it. If the contract requires that specific listed products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provisions to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

PART 2 PRODUCTS

2.1 Y2K COMPLIANT PRODUCTS

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, telecommunication equipment, and components utilizing microcomputer, or minicomputer.

2.2 EQUIPMENT AND COMPONENTS

Equipment and components shall conform to applicable requirements of NFPA 70.

Units of the same type of the equipment shall be product of single manufacturer. Units to be mounted outside or subject to inclement conditions shall be weatherproof or to be mounted in weatherproof enclosures.

2.2.1 Type 1 System: Direct Connected Keyed Intercommunication System

Provide master stations and remote stations in the quantities indicated. Each master station shall selectively communicate with any other master station and any remote station by actuating an appropriate selector switch.

2.2.1.1 Master Station

Recessed wall mounted master stations shall as a minimum conform to the following specifications:

- a. Capacity: Accommodate 2 stations
- b. Speaker sensitivity: Minimum 40 dB

2.2.1.2 Intercommunication Amplifier

Intercommunication amplifier shall as a minimum conform to the following

specifications:

- a. Output power: 2 watts rms or greater
- b. Total harmonic distortion: Less than 5 percent at rated power with a load equivalent to one station connected to output terminals
- c. Signal-to-noise ratio: 60 dB or greater at rated output
- d. Frequency response ratio: Plus or minus 2 dB from 200 Hz to 10,000 Hz

2.2.1.3 Remote Station

Recessed wall mounted weatherproof remote station shall have stainless faceplate with temper proof mounting screws and galvanized steel backbox with "station call-in" capabilities. Remote station shall provide a speaker with a minimum sensitivity of 40 dB for speakers less than 8 inches in diameter and 45 dB for speakers 8 inches or greater. Remote station shall have a call announcement monitor lamp.

2.3 CABLES AND RACEWAYS

Cable and raceways shall conform to UL 6 and UL 797. Cabinets and boxes shall conform to UL 50.

2.3.1 Speaker Cable

Basic cables shall be single twisted pair shielded cables, 22 gage, stranded tinned copper with vinyl insulation aluminum polyester shield, stranded tinned copper wire with overall vinyl jacket. Multi-conductor shielded pair cables conforming to basic speaker cable specifications are acceptable.

2.3.2 Microphone Cable

Cable shall be single conductor shielded cable stranded copper No. 25 AWG rubber insulated, tinned copper shield and rubber overall jacket.

2.4 TERMINALS

Terminals shall be solderless, tool-crimped pressure type.

2.5 SURGE PROTECTION

Major components of the system such as master stations, amplifiers, and remote stations, shall have a device, either internal or external, which shall provide protection against voltage spikes and current surges conforming to IEEE C62.41.

2.6 SPEAKER ENCLOSURES

Speaker enclosures shall be compatible with the speakers specified and shall comply with UL 50.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Install all system components and appurtenances in accordance with the manufacturer's instructions and as specified herein.

3.1.2 Wiring

Wiring shall be installed in rigid metal conduit, intermediate metal conduit, cable tray, or electric metallic tubing as specified in Section 16402, "Interior Distribution System." Wiring for signal circuits shall terminate on identified terminal blocks in cabinets and master station enclosures. Terminate audio circuits on identified terminal blocks in cabinets and master stations. Cable shield shall be grounded at all points of termination.

3.1.2.1 Signal Wiring and Control Wiring

Signal and control circuits shall be installed in accordance with NFPA 70. Type of signal and control wires and number of conductors shall be provided as recommended by the intercommunication system manufacturer, and as necessary to provide a complete and operable system.

3.1.3 Grounding

NFPA 70. Ground and distribution ground buses shall be solid copper wire with insulating covering.

3.2 FIELD QUALITY CONTROL

3.2.1 Acceptance Tests

After installation has been completed, Contractor shall conduct an acceptance test in the presence of the Contracting Officer or its representative, to demonstrate that the equipment operates in accordance with specification requirements. Contractor shall notify the Contracting Officer 2 weeks prior to performance of tests. The acceptance tests shall include originating and accepting messages at specified stations, at proper volume levels, without cross-talk or noise from other links or non-designated units. Test shall utilize the phonetically balanced monosyllabic word intelligibility test in accordance with ANSI S3.2 (ASA 85).

In order to be acceptable a score of at least 75 percent must be obtained for each system test.

3.2.2 Retesting

Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense.

3.3 INSPECTION

Make observations to verify that units and controls are properly labeled,
and interconnecting wires and terminals identified.

-- End of Section --

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		C	SD-01 Preconstruction Submittals															
			Schedule of prices															
		C	SD-01 Preconstruction Submittals															
			List of contact personnel															
			Insurance															
			Personnel List															
			Vehicle list															
			Statement of Acknowledgement															
			Form SF 1413															
		C	SD-01 Preconstruction Submittals															
			Construction schedule															
			Equipment delivery schedule															
		C	SD-11 Closeout Submittals															
			Submittal register															
		C	SD-01 Preconstruction Submittals															
			(QC) plan															
		C	SD-01 Preconstruction Submittals															
			Construction site plan															
			SD-03 Product Data															
			Backflow preventers															
			SD-06 Test Reports															
			Backflow Preventer Tests															
			SD-07 Certificates															
			Backflow Tester															
		C	SD-07 Certificates															
			Accident Prevention Plan (APP)															

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		01	Activity Hazard Analysis (AHA)															
			SD-11 Closeout Submittals															
			Daily Confined Space Entry Permit Reports															
		C	SD-01 Preconstruction Submittals															
			Construction Sequence Schedule															
			SD-03 Product Data															
			Sediment Fence															
			Dust Suppressors															
			Filter Cloth Underliner															
		C	SD-01 Preconstruction Submittals															
			Waste Management Plan															
		C	SD-06 Test Reports															
			Laboratory analysis															
			Laboratory analysis															
			SD-11 Closeout Submittals															
			Preconstruction survey															
			Solid waste disposal permit															
			Waste determination documentation															
			Waste determination documentation															
			Disposal documentation for hazardous and regulated waste															
			Contractor 40 CFR employee training records															
			Regulatory notification															
			Solid waste disposal report															

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	01	Contractor Hazardous Material Inventory Log															
	C	SD-10 Operation and Maintenance Data															
		Equipment/product warranty list															
		SD-11 Closeout Submittals															
		As-built drawings															
		Record of materials															
		Utility as-built drawings															
		Equipment/product warranty tag															
	C	SD-06 Test Reports															
		Borrow Site Testing															
		Fill and backfill															
		Select material															
		Porous fill															
		Density tests															
	C	SD-03 Product Data															
		Piping Materials															
		Water distribution main															
		Water service line															
		Hydrants															
		Indicator posts															
		Corporation stops															
		Valve boxes															
		Valve boxes															
		Fire Department Connection															

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		C	SD-02 Shop Drawings															
			Metal items															
			SD-03 Product Data															
			Pipeline materials															
		C	SD-02 Shop Drawings															
			Gates	2.1.2														
			Post spacing															
			Location of gate, corner, end, and pull posts															
			SD-03 Product Data															
			Chain-link fencing															
			Accessories															
			SD-06 Test Reports															
			Weight in ounces for zinc coating															
			SD-08 Manufacturer's Instructions															
			Fence	3.2														
		C	SD-05 Design Data															
			Job mix formula															
			SD-07 Certificates															
			Stone Base Course															
		C	SD-02 Shop Drawings															
			Reinforcing steel															
			SD-03 Product Data															
			Materials for curing concrete															
			Joint sealants															
			Joint filler															

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	03	Vapor barrier														
		SD-05 Design Data														
		mix design														
		SD-06 Test Reports														
		Concrete mix design														
		Fly ash														
		Pozzolan														
		Ground iron blast-furnace slag														
		Compressive strength tests														
		Unit weight of structural lightweight concrete														
		Ion Concentration														
	C	SD-02 Shop Drawings														
		Drawings of precast members														
		SD-03 Product Data														
		inserts														
		Bearing pads														
		SD-04 Samples														
		Surface Finish														
		SD-05 Design Data														
		design calculations														
		Concrete mix design														
		SD-06 Test Reports														
		Contractor-furnished mix design														
		SD-07 Certificates														
		Fabrication														

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	C	SD-11 Closeout Submittals															
		batch ticket															
	C	SD-02 Shop Drawings															
		Reinforcing steel															
		Movement joints															
		SD-03 Product Data															
		Masonry accessories															
		Reinforcement															
		Control joints															
		Water-repellant admixture															
		Flashing															
		SD-04 Samples															
		Masonry units															
		Mortar color															
		Masonry panel															
		SD-06 Test Reports															
		Unit strength method															
		Mortar properties															
		Grout	2.3														
		Efflorescence test															
		Grout strength															
		Mortar strength and properties															
		SD-07 Certificates															
		Concrete masonry units															
		Building brick															
		Facing brick															

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	04	Water-repellant admixture														
		SD-08 Manufacturer's Instructions														
		Masonry cement														
	C	SD-02 Shop Drawings														
		Details of steel reinforcement														
		Lintels														
		SD-03 Product Data														
		Anchors, ties														
		Wire reinforcement														
		Movement joints														
		SD-04 Samples														
		Concrete masonry units														
		Precast concrete														
		Sample panel														
		SD-06 Test Reports														
		Unit strength method														
		Mortar properties														
		Grout	2.3													
		Concrete masonry units														
		admixtures														
		Grout strength														
		Mortar Strength and Properties														
		Field Prism Test														
		SD-07 Certificates														
		Cold weather installation														
	C	SD-02 Shop Drawings														

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	05	Fabrication drawings														
		SD-03 Product Data														
		Shop primer														
		SD-06 Test Reports														
		Class B coating														
		Bolts, nuts, and washers														
		SD-07 Certificates														
		Steel	2.1													
		Bolts, nuts, and washers														
		Shop primer														
		Welding electrodes and rods														
		Nonshrink grout														
		Galvanizing														
	C	SD-02 Shop Drawings														
		Trussed rafters														
		Trussed joists														
		Fabricated structural members														
		Modifications of structural members														
		SD-05 Design Data														
		Modifications of structural members														
		SD-06 Test Reports														
		Preservative-treated														
		SD-07 Certificates														
		Certificates of grade														
	C	SD-03 Product Data														
		Blanket insulation														

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	07	Accessories														
		SD-08 Manufacturer's Instructions														
		Insulation														
	C	SD-03 Product Data														
		Block or board insulation														
		Vapor retarder														
		Pressure sensitive tape														
		Protection board or coating														
		Accessories														
		SD-08 Manufacturer's Instructions														
		Block or Board Insulation														
		Adhesive														
	C	SD-03 Product Data														
		Loose fill insulation														
		SD-08 Manufacturer's Instructions														
		Loose Fill Insulation														
	C	SD-02 Shop Drawings														
		Shop drawings														
		SD-03 Product Data														
		Sheathing board														
		Thermal insulation														
		Adhesive														
		Mechanical anchors														
		Accessories														
		Base coat														
		Portland cement														

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				S U B M I T	A P P R C N E E D E D B Y	M A T E R I A L N E E D E D B Y	A C T I O N C O L E	D A T E O F A C T I O N	D A T E F R O M C O N	D A T E F T O O T R E V I E W	D A T E R F R O M C R E V I E W E R	D A T E O F A C T I O N					
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		07	Reinforcing fabric														
			Finish coat														
			Sealant														
			Primer														
			Bond breaker														
			Backer Rod														
			Warranty														
			SD-04 Samples														
			EIFS Components														
			Mock-up of EIFS														
			SD-05 Design Data														
			Wind load														
			Moisture analysis														
			SD-06 Test Reports														
			Abrasion resistance														
			Accelerated weathering														
			Impact resistance														
			Mildew resistance														
			Salt spray resistance														
			Water vapor transmission														
			Absorption-freeze-thaw														
			Absorption-freeze-thaw														
			Flame spread														
			Flame spread														
			Water penetration														
			Water resistance														

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		07	Full scale or immediate scale fire test															
			Radiant heat															
			Fire Endurance															
			Wind load															
			SD-07 Certificates															
			Qualification of Installer															
			Qualification of Sealant Applicator															
			EIFS Inspection Check List															
			SD-08 Manufacturer's Instructions															
			Substrate															
			Installation															
			SD-10 Operation and Maintenance															
			Data															
			EIFS	1.9														
		C	SD-02 Shop Drawings															
			Covering on flat, sloped, or curved surfaces															
			Fascias		;													
			SD-11 Closeout Submittals															
			Quality Control Plan															
		C	SD-02 Shop Drawings															
			Roofing		;													
			SD-03 Product Data															
			Roofing panels															
			Attachment clips															

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(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	
	07	Closures															
		Accessories															
		Fasteners															
		Sealants															
		warranty															
		SD-04 Samples															
		panel	2.1														
		Accessories															
		Sealants															
		Intermediate Support															
		SD-05 Design Data															
		Design calculations															
		SD-06 Test Reports															
		Field Inspection															
		Structural performance															
		Finish															
		SD-07 Certificates															
		Manufacturer's Technical															
		Representative															
		Installer's Qualifications															
		Coil stock															
		SD-08 Manufacturer's Instructions															
		Installation															
		SD-11 Closeout Submittals															
		Information card															
	C	SD-03 Product Data															

CONTRACT NO. 140271-1000-1070

CONTRACTOR

[illegible]

SUBMITTAL REGISTER

CONTRACT NO.

102-7100010-10

TITLE AND LOCATION

CONSTRUCT ARMORY, MCAF QUANTICO, VA

CONTRACTOR

TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARA #	GOVT OR A/E REVIEWR	CONTRACTOR: SCHEDULE DATES		CONTRACTOR ACTION		APPROVING AUTHORITY						REMARKS		
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		08	Installation														
			SD-10 Operation and Maintenance Data														
			Hardware Schedule														
			SD-11 Closeout Submittals														
			Key biting														
		C	SD-08 Manufacturer's Instructions														
			Setting and sealing materials														
			Glass setting														
		C	SD-03 Product Data														
			Accessories														
		C	SD-04 Samples														
			Ceramic floor tile														
			wall tile														
			trim units														
			accessories														
		C	SD-02 Shop Drawings														
			Piping identification														
			SD-03 Product Data														
			Coating														
			SD-04 Samples														
			Color	1.1C	G												
			SD-08 Manufacturer's Instructions														
			Manufacturer's material safety data sheets														
			SD-07 Certificates														

SUBMITTAL REGISTER

CONTRACT NO.

1024710001070

TITLE AND LOCATION

CONSTRUCT ARMORY, MCAF QUANTICO, VA

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	00	Applicator's qualifications															
		Evidence of acceptable variation															
	1	SD-02 Shop Drawings															
		Types	2.1	G													
		Location															
		Installation															
		Numbering system															
		SD-03 Product Data															
		Material															
		Finish															
		components															
		Assembly															
		SD-04 Samples															
		Color chips															
	1	SD-03 Product Data															
		Manufactured units															
		SD-04 Samples															
		Manufactured units															
		SD-07 Certificates															
		Manufactured units															
	1	SD-02 Shop Drawings															
		Security vault doors															
		SD-03 Product Data															
		Security vault doors															
		SD-08 Manufacturer's Instructions															
		Installation															

SUBMITTAL REGISTER

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CONSTRUCT ARMORY, MCAF QUANTICO, VA

CONTRACTOR

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						SUBMIT	APPRC NEEDE BY	MATERI NEEDE BY	A C T I O N C O L E	DAT OF ACTIO	DATE FWD TO APPR AUTH/	DATE F RO CON	DATE F TO OT REVIEW	DATE R FROM C REVIEWER			A C T I O N C O L E	DAT OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH
(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)										
		1	SD-02 Shop Drawings																
			System floor plans																
			System wiring diagrams																
			Conductor wire marker schedule																
			SD-03 Product Data																
			Control panel																
			Storage batteries																
			Battery charger																
			Manual pull stations																
			Open-area (spot-type) smoke detectors																
			Alarm horns																
			Visible appliances																
			Wiring		G														
			Ground rods																
			Conduit																
			Outlet boxes																
			Fittings for conduit and outlet boxes																
			Surge suppression devices																
			SD-05 Design Data																
			Power calculations																
			SD-06 Test Reports																
			2-wire smoke detectors																
			Preliminary testing																
			Final acceptance testing																
			SD-07 Certificates																

SUBMITTAL REGISTER

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102-710001070

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CONSTRUCT ARMORY, MCAF QUANTICO, VA

CONTRACTOR

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						SUBMIT	APPRC NEEDE BY	MATERI NEEDE BY	A C T I O N C O L E	DATE FWD TO APPR AUTH/	DATE F TO OT REVIE	DATE R FROM C REVIEWER	A C T I O N C O L E	DATE RCD FRM APPR AUTH			
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		13	Qualifications of installer														
			Qualifications of System Technician														
			Year 2000 (Y2K) Compliance														
			Warranty														
			SD-10 Operation and Maintenance														
			Data														
			Fire alarm system														
			SD-11 Closeout Submittals														
			System as-built drawings														
		1	SD-02 Shop Drawings														
			Sprinkler heads and piping system														
			layout														
			Electrical wiring diagrams														
			SD-03 Product Data														
			Piping		G												
			Valves		G												
			Water motor alarms														
			Sprinkler heads														
			Pipe hangers and supports														
			Fire department connections														
			Low air pressure supervisory switch														
			Dry pipe valves														
			Air compressor														
			Mechanical couplings														
			Backflow Preventers														
			Pressure Switch														

SUBMITTAL REGISTER

CONTRACT NO.

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CONSTRUCT ARMORY, MCAF QUANTICO, VA

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	1	SD-05 Design Data																
		Sprinkler system design																
		SD-06 Test Reports																
		Preliminary tests																
		SD-07 Certificates																
		Qualifications of installer																
		SD-10 Operation and Maintenance																
		Data																
		Dry pipe valves																
		Air compressor																
		SD-11 Closeout Submittals																
		As-built drawings of each system																
	1	SD-03 Product Data																
		Piping insulation and jacket																
		Duct insulation and jacket																
		Equipment insulation and jacket																
	1	SD-03 Product Data																
		Air Dryer																
		Pipe	2.3.1															
		Fittings																
		Valves																
		Pressure gages																
		Hangers and supports																
		Quick disconnect couplings																
		Filters																
		Strainers																

SUBMITTAL REGISTER

CONTRACT NO.

1024710001070

TITLE AND LOCATION

CONSTRUCT ARMORY, MCAF QUANTICO, VA

CONTRACTOR

(a)	(b)	(c)	(d)	(e)	(f)	CONTRACTOR: SCHEDULE DATES		CONTRACTOR ACTION		APPROVING AUTHORITY					(q)	(r)		
						SUBMIT	APPRC NEEDE BY	MATERI NEEDE BY	A C T I O N	DATE FWD TO APPR AUTH/	DATE FRO CON	DATE F TO OT REVIEW	DATE R FROM C REVIEWER	A C T I O N			DATE OF ACTION	DATE RCD FRM APPR AUTH
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		15	Traps	2.3.9														
			Flexible connections															
			Dielectric unions															
			Hose reel assembly															
			Identification labels for piping															
			Tubing															
			SD-06 Test Reports															
			Hydrostatic tests															
			Leak tightness tests															
			SD-07 Certificates															
			Welding and brazing procedures															
			Welding procedure qualifications															
			Cleaning and flushing procedures															
			SD-10 Operation and Maintenance															
			Data															
			Air dryer															
			SD-11 Closeout Submittals															
			air compressor															
		1	SD-03 Product Data															
			Flush valve water closets															
			Wall hung lavatories															
			Countertop sinks															
			Water heaters															
			Shower faucets															
			SD-10 Operation and Maintenance															
			Data															

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CONTRACT NO.

1524710001070

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CONSTRUCT ARMORY, MCAF QUANTICO, VA

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	15	Water heaters															
	1	SD-03 Product Data															
		Split-system heat pumps															
		Electric baseboard units															
		Exhaust fans															
		Diffusers, registers, and grilles															
		Charcoal filter rack and filter															
		SD-08 Manufacturer's Instructions															
		Installation manual															
		SD-10 Operation and Maintenance															
		Data															
		Split-system heat pumps															
		Electric baseboard units															
		Exhaust fans															
		Charcoal filter rack and filter															
	1	SD-01 Preconstruction Submittals															
		List of shop drawings															
		List of symbols and abbreviations used on shop drawings															
		List of I/O points															
		Equipment components list															
		AC power table															
		SD-02 Shop Drawings															
		Control system schematic															
		Ladder diagrams															
		Component wiring diagrams															

SUBMITTAL REGISTER

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102-7100010-10

TITLE AND LOCATION

CONSTRUCT ARMORY, MCAF QUANTICO, VA

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	15	Terminal strip diagrams																
		SD-03 Product Data																
		DDC hardware																
		DDC capabilities																
		Workstation software																
		Input devices																
		Output devices																
		Surge and transient protection																
		Hand-held terminal																
		Panel mounted display and keypad																
		SD-05 Design Data																
		Temperature sensor accuracy																
		Temperature sensor five year stability																
		SD-06 Test Reports																
		Field tests																
		Performance verification tests																
		SD-07 Certificates																
		Direct digital controllers																
		Test equipment accuracy																
		Contractors' qualifications																
		Training course materials																
		SD-10 Operation and Maintenance																
		Data																
		Controls and HVAC System																
		Operators Manual																

SUBMITTAL REGISTER

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		15	DDC Manufacturer's Hardware and Software Manuals														
			SD-11 Closeout Submittals														
			Training course documentation														
			Service organization														
			Contractor certification														
		1	SD-06 Test Reports														
			Certified TAB report														
			SD-07 Certificates														
			Design review report														
			Pre-field TAB engineering report														
			Advanced notice for TAB field work														
		1	SD-06 Test Reports														
			Acceptance tests and inspections														
			SD-07 Certificates														
			Qualifications														
			Acceptance test and inspections procedure														
		1	SD-02 Shop Drawings														
			Pad-mounted transformer drawings														
			SD-03 Product Data														
			Pad-mounted transformers														
			SD-06 Test Reports														
			acceptance checks and tests														
			Ground resistance test reports														
			SD-07 Certificates														

SUBMITTAL REGISTER

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						(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)			(p)	
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		16	Year 2000 (Y2K) Compliance Warranty Transformer losses SD-09 Manufacturer's Field Reports design tests routine and other tests SD-10 Operation and Maintenance Data Transformer(s) SD-11 Closeout Submittals Transformer test schedule															
		1	SD-03 Product Data Medium voltage cable Medium voltage cable terminations Medium voltage cable joints SD-06 Test Reports Arc-proofing test Medium voltage cable qualification and production tests Field Acceptance Checks and Tests SD-07 Certificates Cable splicer/terminator															
		1	SD-02 Shop Drawings Panelboards SD-03 Product Data Receptacles															

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		16	Circuit breakers															
			Switches															
			Motor controllers															
			Manual motor starters															
			SD-06 Test Reports															
			600-volt wiring test															
			Grounding system test															
			Ground-fault receptacle test															
			SD-07 Certificates															
			Fuses	2.12	G													
			Year 2000 (Y2K) Compliance															
			Warranty															
		1	SD-03 Product Data															
			Fluorescent lighting fixtures															
			Fluorescent electronic ballasts															
			Fluorescent lamps															
			High-intensity-discharge (HID)															
			lighting fixtures															
			HID ballasts															
			High-pressure sodium (HPS) lamps															
			Time switch															
			Emergency lighting equipment															
			SD-06 Test Reports															
			Operating test															
			SD-11 Closeout Submittals															
			Information card															

SUBMITTAL VERIFICATION RESULTS

This report shows Submittal Items and Submittal Descriptions that have errors. Search Help on "Submittal Formatting Requirements" for error explanations.

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Submittal Items not listed in/outside the Submittal Article; Submittal Descriptions and Classifications found outside the Submittal Article; and invalid Classifications:

SECTION	SUBPART	TYPE OF SUBMITTAL ERROR
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Submittal Descriptions that differ from Descriptions in the Submittal Procedure Section (01300 or 01330):

STANDARD DESCRIPTION

SECTION	SUBPART	INVALID DESCRIPTION
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All the Submittal Descriptions in Sections processed match.

McCALLUM

TESTING LABORATORIES, INC.

Geotechnical Engineering, Materials Testing & Environmental Services

SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING

BUILDING 2106 AND NEW ARMORY BUILDING

QUANTICO MARINE BASE

QUANTICO, VIRGINIA

MTL PROJECT #00-1778

Prepared for: Ivy Architectural Innovations
380 Cleveland Place
Virginia Beach, Virginia 23462

Attention: Richard Ivy, AIA

McCALLUM

TESTING LABORATORIES, INC.

Geotechnical Engineering, Materials Testing & Environmental Services

November 17, 2000

IVY ARCHITECTURAL INNOVATIONS

380 Cleveland Place
Virginia Beach, Virginia 23462

Attention: **Richard Ivy, AIA**

Subject: **SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING**
Building 2106 and New Armory Building
Quantico Marine Base
Quantico, Virginia
MTL Project #00-1778

Dear Mr. Ivy:

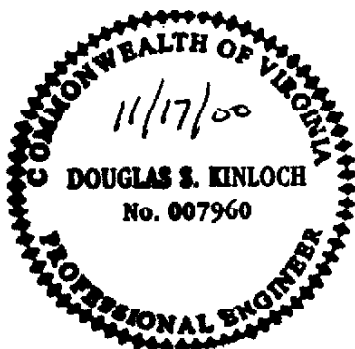
McCALLUM TESTING LABORATORIES, INC. is pleased to present this report of subsurface exploration and geotechnical engineering services for the above referenced project. Included in this report are:

1. A brief description of the project;
2. An outline of the services performed;
3. A tabulation of the subsurface conditions encountered;
4. Our groundwater observations; and
5. Our detailed recommendations for site preparation and the design and construction of foundations and ground slabs.

Should you have any questions concerning this report, please do not hesitate to contact this office at your earliest convenience.

Very truly yours,

McCALLUM TESTING LABORATORIES, INC.

A handwritten signature of Douglas S. Kinloch in black ink.

DOUGLAS S. KINLOCH, P.E.
CHIEF ENGINEER

PROJECT INFORMATION

Building 2106 is located on the west side of Rowell Road, just south of Cleveland Street within the Marine Base at Quantico, Virginia. The existing structure has experienced moisture problems in the northernmost basement area.

The proposed Armory is to be located west of Rowell Road and south of Sailer Street in an existing grass covered recreational field. We understand the proposed armory will be a one story, steel frame structure with plan dimensions of approximately 40 ft. by 55 ft. It will likely be supported by steel columns carrying maximum loads of less than 35 kips. The ground floor slab will likely be set at a finished floor elevation of 1 to 2 ft. above existing grade. Maximum ground slab live loads are expected to be 150 psf.

SCOPE OF SERVICES

The evaluation of the groundwater conditions at Building 2106 and the evaluation of the site for the proposed armory required both the collection of subsurface data and the performance of various geotechnical analyses. These analyses were based on our experience with local conditions, available foundation types and site preparation methods. All work was directed and supervised by a Professional Engineer specializing in geotechnical design and construction. This written report which describes the exploration, presents our Building 2106 groundwater observations and provides our recommendations for site preparation and the design and construction of foundations and ground slabs for the new armory was prepared after reviewing the project information provided to us and analyzing the subsurface data collected for the project.

McCallum Testing Laboratories, Inc. drilled a total of four soil test borings extending to depths of 20.5 ft. each beneath the existing ground surface. Two borings were drilled adjacent to the north end of Building 2106 and two borings were drilled in the area proposed for the new armory. Standard Penetration Tests (SPT's) were performed at 2 ft. intervals in the upper 10 ft. of boring and at 5 ft. intervals below 10 ft. Groundwater monitoring wells were installed within the two borings adjacent to Building 2106 and stabilized groundwater level observations were made after 24 hours. In addition, a series of six 2 inch diameter holes were drilled within the basement slab at the north end of Building 2106 to help observe moisture conditions directly beneath the slab. All drilling and sampling was performed in accordance with applicable ASTM Standards. At the completion of drilling at the armory site, water level measurements were made within the completed bore holes. All samples obtained from the borings were visually examined by a Geotechnical Engineer and visually classified according to the Unified Soils Classification System.

A Site Location Plan, a Boring Location Plan, a Basement Slab Exploration Plan, Subsurface Profiles and the detailed results of field sampling and testing are presented in the Appendix to this report.

SUBSURFACE CONDITIONS

Stratigraphy

Beneath a surface veneer of topsoil, generally 2 inches thick, the borings encountered a layer of man-placed fill overlying Coastal Plain Sediments. A summarization of the subsurface conditions encountered is presented in the following tabulations:

BUILDING 2106

STRATUM	AVERAGE DEPTH (FT)	DESCRIPTION	STANDARD PENETRATION RESISTANCE (BLOWS/FT)
A	0.1 - 9.0 ⁽¹⁾	Fill and Possible Fill – Medium compact to very loose, moist, brown, silty, clayey, fine sand (SC) and medium stiff to soft, moist, grayish brown, silty, fine sand (CL)	24 to 4 Decreasing With Depth
1	9.0 - 20.5 ⁽²⁾	Very loose to medium compact, wet, grayish brown, silty and clayey, fine sand (SM,SM-SC,SC) with traces of gravel	4 to 13
2 ⁽³⁾	17.0 - 20.5 ⁽²⁾	Medium stiff, wet, gray mottled brown, fine sandy, silty clay (CH)	8
NOTES: (1) Varies from 6 ft. to 12 ft. (2) Maximum Depth of Exploration (3) Encountered at Boring B-1 only			

ARMORY

STRATUM	AVERAGE DEPTH (FT)	DESCRIPTION	STANDARD PENETRATION RESISTANCE (BLOWS/FT)
A	0.2 - 2.0	Possible Fill – Medium compact, moist, brown silty, clayey, fine sand (SC)	11 to 20
1	2.0 - 20.5*	Loose to medium compact, moist to wet, grayish brown to gray, silty and clayey to clean, fine sand (SM,SC,SP)	8 to 24
* Maximum Depth of Exploration			

Groundwater

The stabilized groundwater level measured in the two monitor wells adjacent to Building 2106 indicate the level of groundwater to be 9.5 to 10.5 ft. below existing grade. It is anticipated that the measured level of groundwater was 4 to 5 ft. below the basement slab finished floor elevation.

The series of 2 inch diameter holes drilled in the basement slab of Building 2106 revealed the slab to be generally 9 inches thick and underlain by an essentially dry sand and gravel base. The presence of a vapor barrier beneath the slab was not detected. A 30 inch diameter sump near the northeast corner of the basement revealed a water level at 55 inches below the surface of the slab.

Our water level measurements made at the completion of drilling operations at the armory site indicated the level of groundwater to be on the order of 7 ft. below the existing ground surface.

Seasonal groundwater level fluctuations on the order of 2 to 3 feet are not uncommon in this area. Lowest groundwater levels normally occur in late summer and early fall while the highest levels generally occur in late winter and early spring. At the time of our study, we believe groundwater levels were between their seasonal high and low elevations.

RECOMMENDATIONS - ARMORY

Basis

The following recommendations are based on data obtained by this subsurface exploration program, the structural and site orientation data given previously and our past experience within the area. If the project information presented is incorrect or changed in the final design or if site or subsurface conditions encountered during construction differ appreciably from those indicated by this report, this office should be notified to determine the applicability of our recommendations in light of the changed conditions.

Site Preparation

Initially, areas planned to support foundations, ground slabs or new fill should be stripped of all surface vegetation and topsoil. Stripping should extend at least 5 feet beyond building lines. These areas should then be proofrolled with a heavily loaded dump truck and be monitored by the Geotechnical Engineer to locate any pockets of excessively soft surface soils. All areas that deflect excessively or rut and fail to tighten up under continued proofrolling should be undercut to firm material and be replaced with properly compacted fill.

The surface soils to be exposed by the stripping operations have a tendency to become softened and unstable when saturated and worked by equipment. Therefore, the exposed subgrade should be well drained to prevent accumulation of water on the site and construction traffic across the site should be limited as much as possible. It will be most preferable to have the subgrade exposed only during the drier seasons of the year and to limit construction traffic to well defined areas outside the building pad.

After the successful completion of proofrolling and undercutting operations, fill required to reach finished subgrade elevation can be placed. Building pad fills should extend approximately 5 feet beyond building lines. Fill and backfill should be classified as SM, SP-SM, SP or SW by the Unified Soils Classification System, with no more than 20 percent passing the No. 200 sieve. All fill materials proposed for use should be tested and approved by the Geotechnical Engineer prior to their placement on site. All fill and backfill placed beneath the structure should be compacted in loose lifts of 8 inches or less to a minimum of 95 percent of their maximum dry density as determined by the procedures outlined in ASTM D 698.

Foundations

The planned armory structure can be properly supported by a system of conventional shallow spread footings bearing directly in the inorganic near surface soils of Stratum 1 or on properly compacted fill placed directly above Stratum 1. Care should be taken to confirm all existing Stratum A fill is removed from beneath all footing bottoms. Our bearing capacity analyses indicate that conventional shallow spread footings supporting loads of the magnitude indicated earlier in this report will have a sufficient factor of safety against a bearing capacity failure if designed for a net allowable soil bearing pressure of 2500 psf or less. However, under extremely light loads, we recommend wall and column footings maintain minimum width dimensions of 18 inches and 24 inches, respectively, to help prevent a localized punching shear failure of the foundation supporting soils.

For both bearing capacity and frost heave protection considerations, all exterior footing bottoms should extend a minimum of 18 inches below finished exterior grade. Interior footings may be founded at nominal depths below finished subgrade elevation unless the subgrade will be subject to extended periods of freezing temperatures during construction or in service.

Based on the results of our Standard Penetration Testing and the anticipated loading conditions, we expect maximum settlements should be on the order of 1/2 inch. All settlement should have occurred by the completion of construction or shortly thereafter. Our previous experience with similar structures indicates this rate and magnitude of settlement will likely be tolerable; however, this should be confirmed by your Structural Engineer.

Foundation Installation

All foundation excavations should be inspected by the Geotechnical Engineer prior to the placement of reinforcing steel to confirm foundations will bear on soil material comparable to those recommended for foundation support by this report. Where existing Stratum A fill soils or other unsuitable materials are encountered, they must be undercut to firm material as directed by the Geotechnical Engineer. If proper bearing does require over-excavation, the excavations should be backfilled to design footing bottom elevation with properly compacted sand fill (95 percent of ASTM D 698), No. 57 crushed stone compacted to a non-yielding condition, or sacrificial concrete.

Due to the susceptibility of the Stratum 1 clayey soils to strength loss and softening when wet, foundation excavations should not be allowed to sit open for extended periods of time. We recommend all footings be concreted as soon as possible after excavation, preferably the same day, to minimize the potential for damage to foundation soils.

Slabs-On-Grade

The ground floor slabs for the armory can be properly supported on grade. Grade slabs should be jointed around all walls and columns supported by individual foundations such that the slab and adjacent foundations can move independently without causing slab damage. Joints between slab sections should contain through reinforcing or keyways to permit rotational movement without cracking or vertical displacement. To help provide support for any concentrated slab loads, to provide stability to the building pad during construction, and to provide a capillary cutoff and allow for lateral movement of moisture beneath the slab, we recommend at least 4 inches of clean sand (SP or SW) be placed directly beneath the slab. If 4 inches or more of these materials are placed directly beneath the slab as part of building pad construction, a separate porous fill layer will not be required. We further recommend the placement of a vapor barrier between the slab bottom and the sand blanket or subgrade to help prevent interior damage due to excessive moisture.

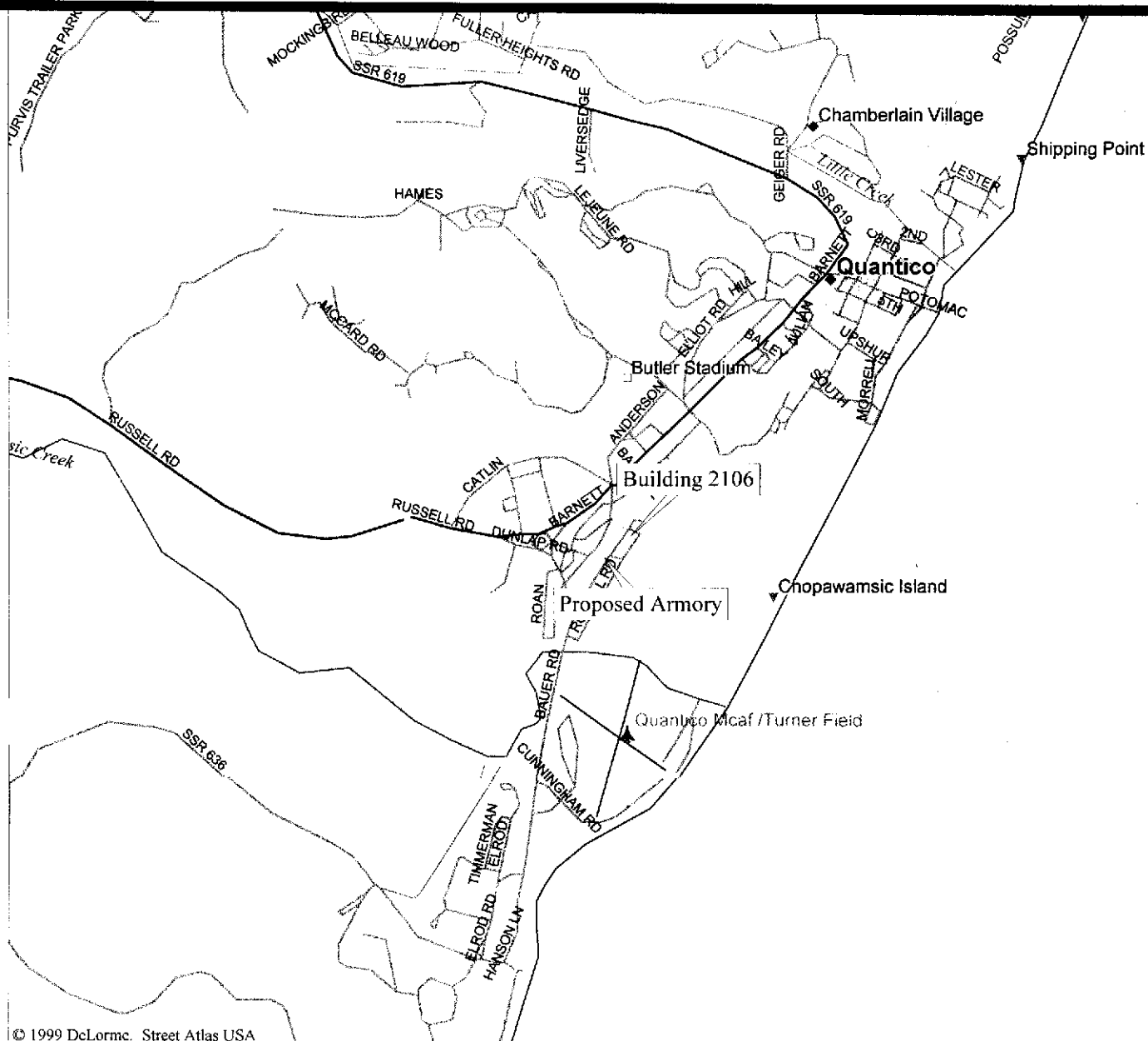
APPENDIX

Site Location Plan

Boring Location Plan

Subsurface Profile

Test Boring Records



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Mag 14.00

Fri Nov 17 14:25 2000

Scale 1:31,250 (at center)

2000 Feet

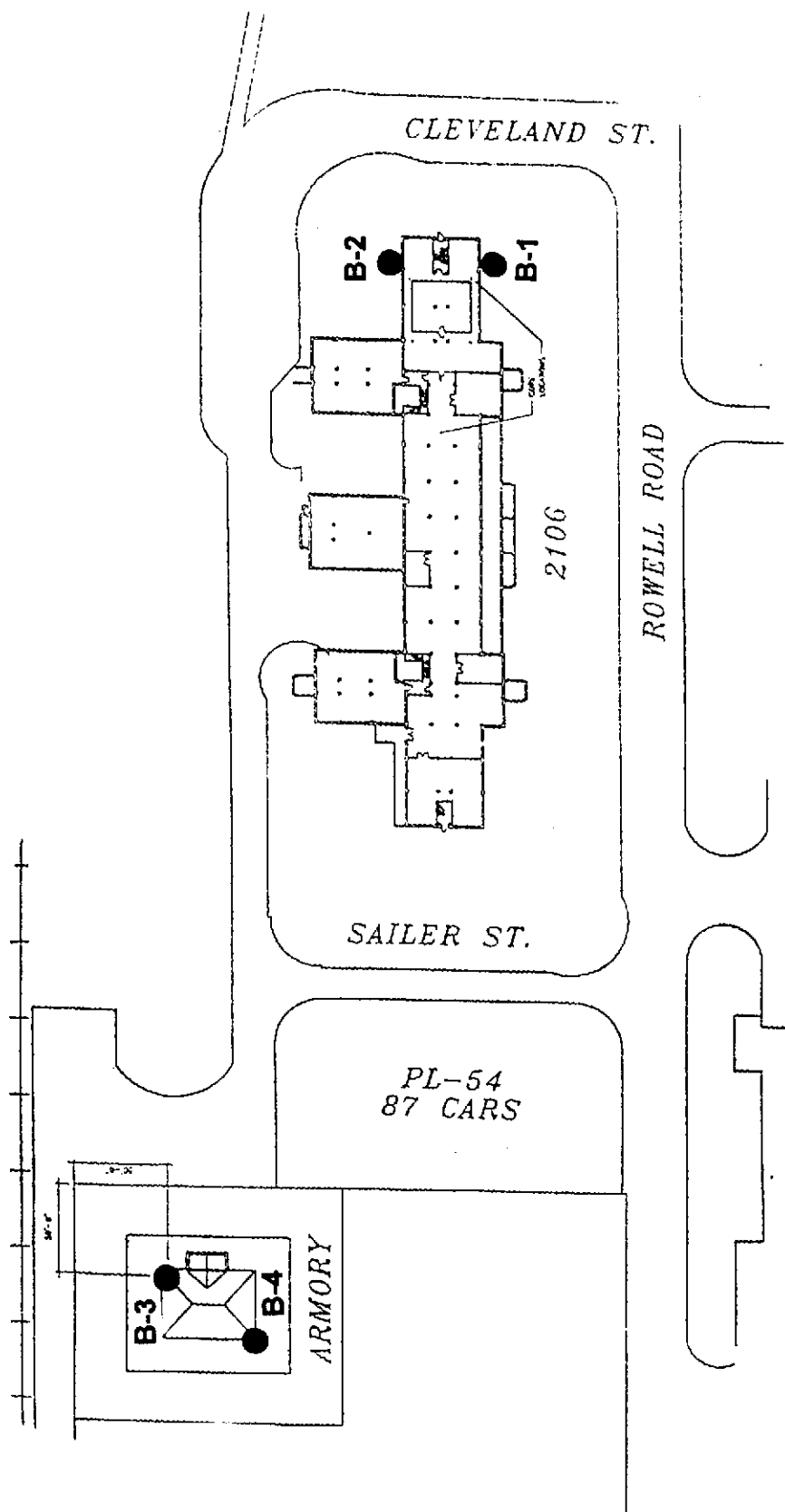
1000 Meters

- Local Road
- Major Connector
- US Highway
- Railroad

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1808 Hayward Avenue
Chesapeake, Virginia 23325-0337

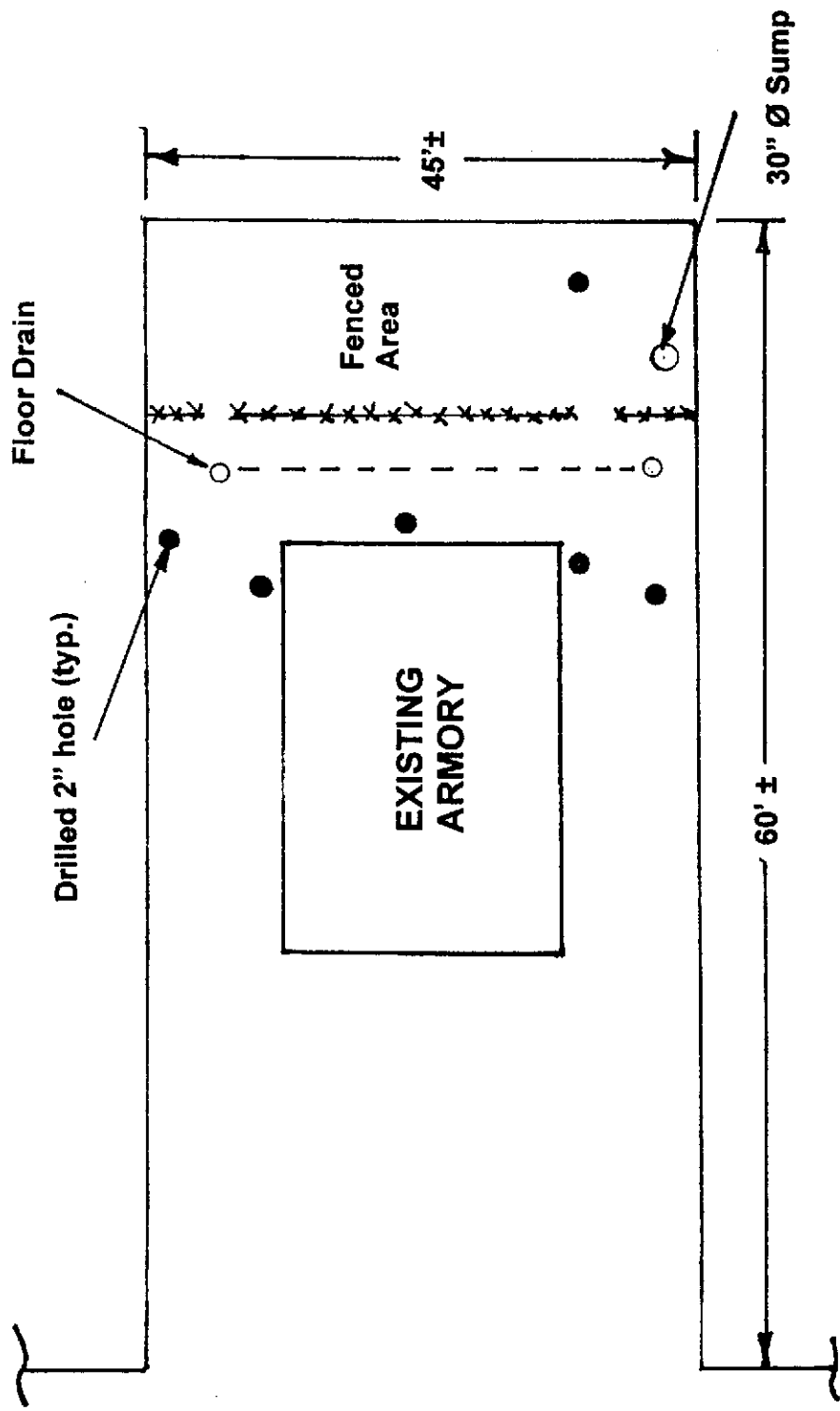
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Project:	Building 2106 and New Armory Building Quantico Marine Base Quantico, Virginia				
Drawing Title:	Site Location Plan				Drawing Number: 1



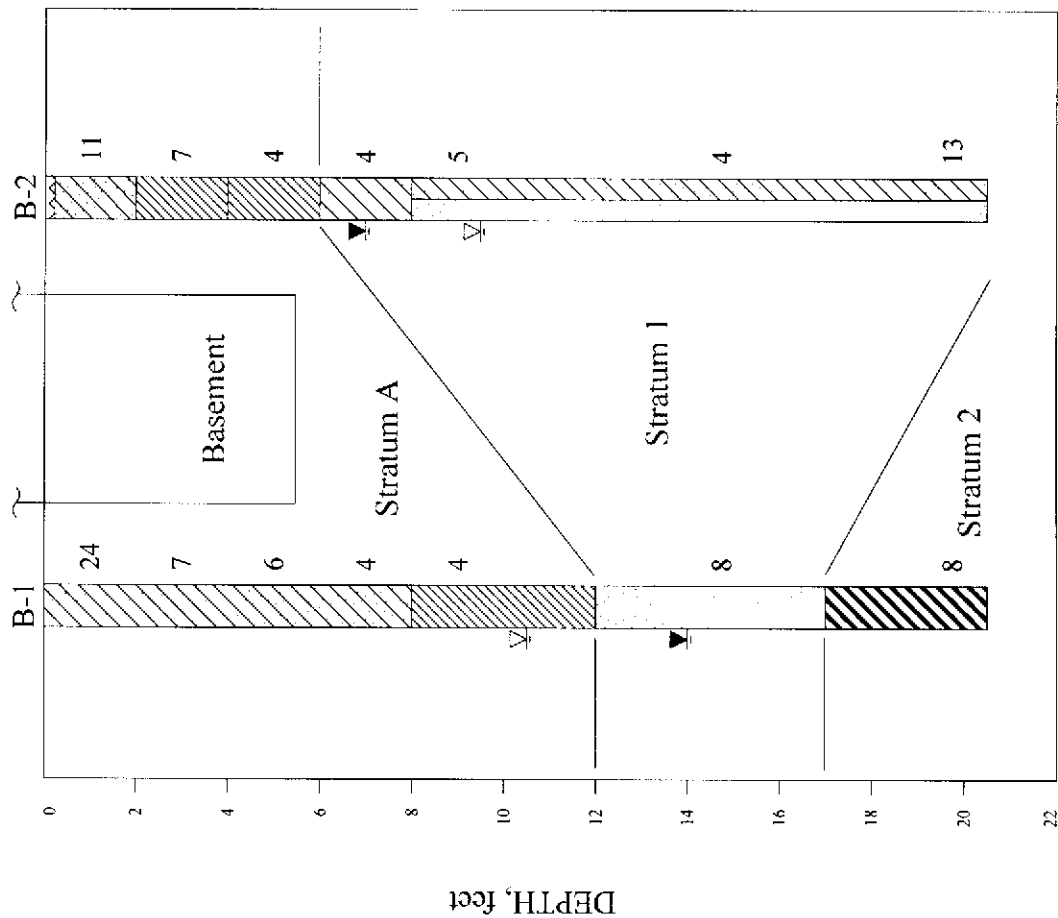
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1808 Hayward Avenue
Chesapeake, Virginia 23325-0337

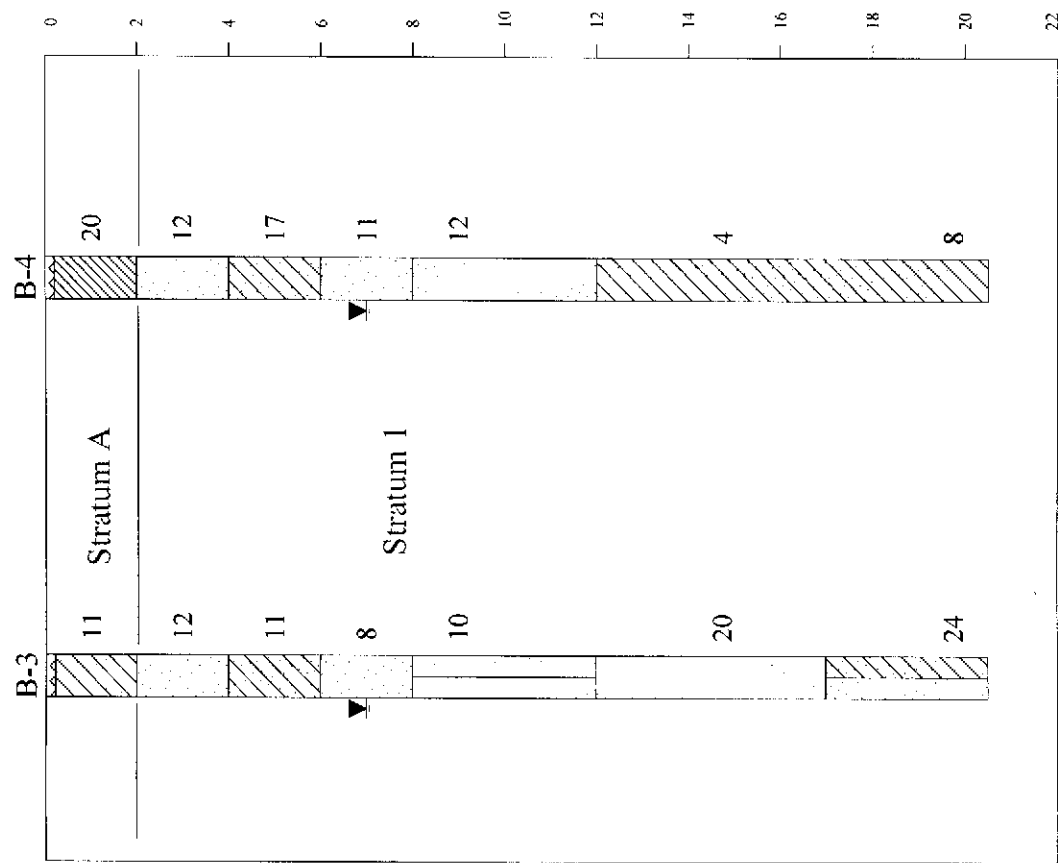
Scale:	1" = 100'	Approved By:	Douglas Kinloch, P.E.	Date:	11/8/00
Project:	Building 2106 and New Armory Building Quantico Marine Base Quantico, Virginia				
Drawing Title:	BORING LOCATION PLAN				Drawing Number: 2



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Scale:	NTS	Approved By:	Douglas Kinloch, P.E.
Project:	Building 2106 Quantico Marine Base Quantico, Virginia		
Drawing Title:	Basement Slab Exploration		Drawing Number: 3
		Date:	11/8/00



Building 2106



New Armory Building

LEGEND

B-1 Boring No.

Groundwater Level After 24 hours

Groundwater Level at Time of Boring

SPT Resistance

Weight of Hammer

Soil Type

Subsurface Profile

Drawing 4

PROJECT Building 2106 and New Armory

PROJECT NO. 00-1778

McCALLUM TESTING LABORATORIES, INC.








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TESTING LABORATORIES, INC.

CHESAPEAKE, VIRGINIA

Unified Soil Classification System ASTM Designation D 2487

Standard Penetration Test (SPT) Resistance Correlations

Coarse Grained Soils (More than 50% of material retained on the No. 200 Sieve)	Gravels (more than 50% retained on the No. 4 Sieve)		GW	Well graded gravels, gravel-sand mixtures, little or no fines
Sands (more than 50% passing the No. 4 Sieve)			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
			GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
			SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands, gravelly sands, little or no fines
			SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine Grained Soils (More than 50% of material passes the No. 200 Sieve)	Silt & Clays (LL less than 50)		ML	Inorganic silts, very fine sands, silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy
			OL	Organic silts and organic silty clays of low plasticity
	Silt & Clays (LL greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, plastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soil			PEAT	Peat and other highly organic soils

Coarse Grained Soils

SPT
vs.
Relative Density

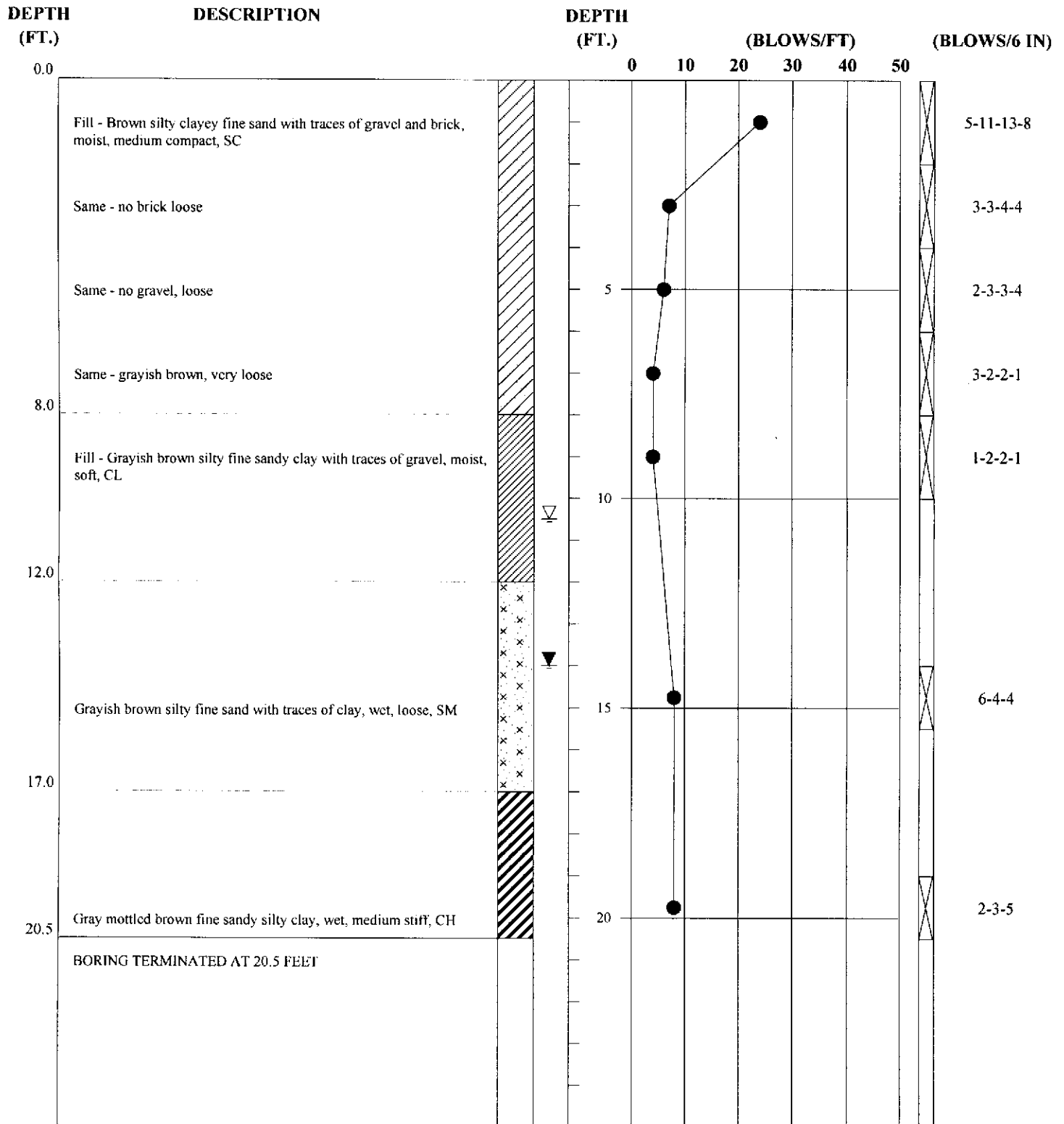
Blows/Ft	Relative Density
0-4	Very Loose
5-10	Loose
11-30	Medium Compact
31-50	Compact
Over 50	Very Compact

Fine Grained Soils

SPT
vs.
Consistency

Blows/Ft	Consistency
0-2	Very Soft
3-4	Soft
5-8	Medium Stiff
9-15	Stiff
16-30	Very Stiff
31-50	Hard
Over 50	Very Hard

STANDARD PENETRATION RESISTANCE



NOTES:

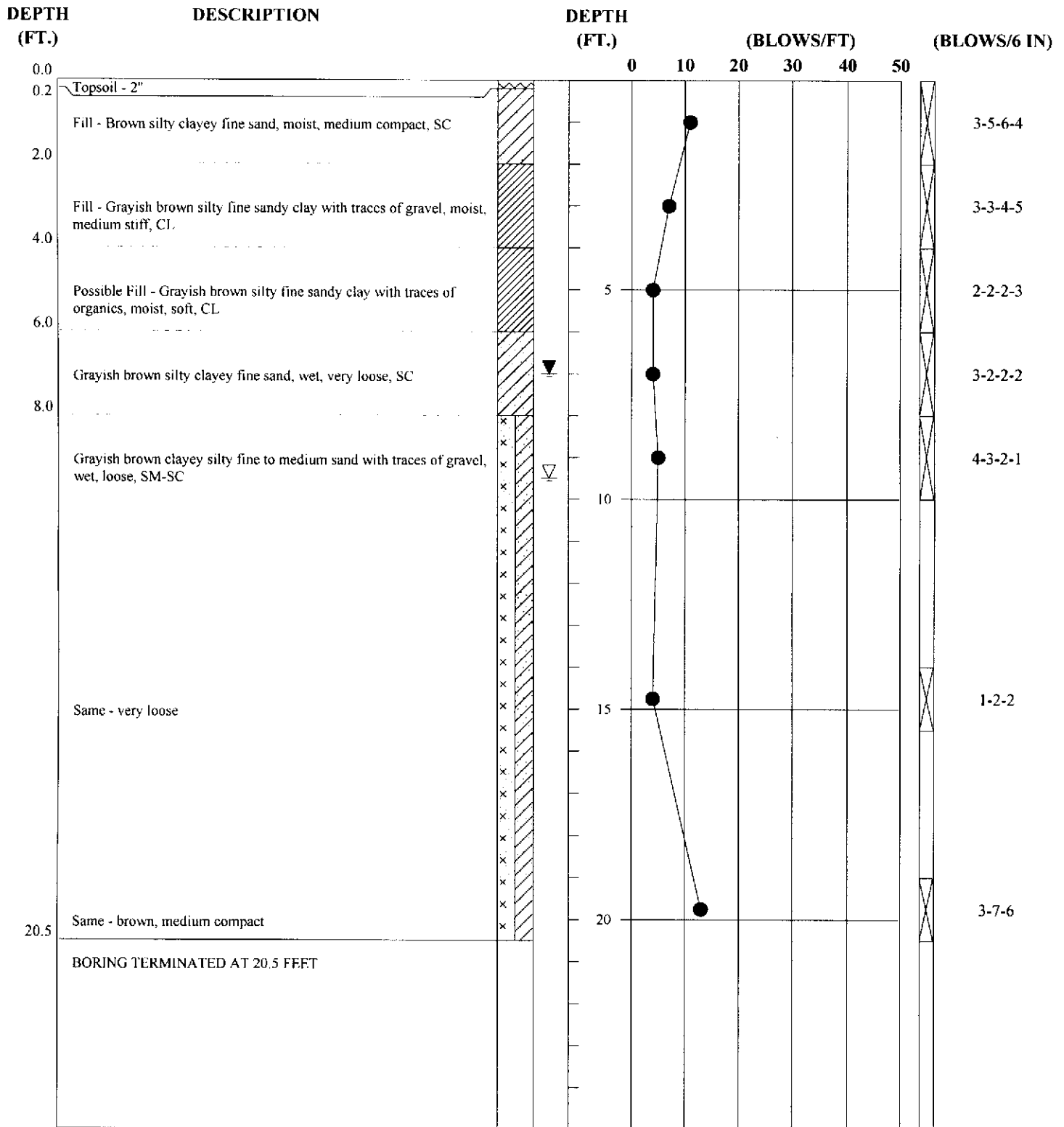
- Gradual Stratum Change
- - - Approximate Stratum Change
- - Penetration Resistance (N - value)
- ⊠ - Standard Penetration Test
- - Undisturbed Sample
- ▽ - Groundwater Level at Time of Boring
- ▽ - Stabilized Groundwater Level Reading

TEST BORING RECORD

BORING NUMBER B-1
DATE DRILLED November 8, 2000
PROJECT NUMBER 00-1778
PROJECT Building #2106
LOCATION Quantico, Virginia

McCALLUM TESTING LABORATORIES, INC.

STANDARD PENETRATION RESISTANCE



NOTES:

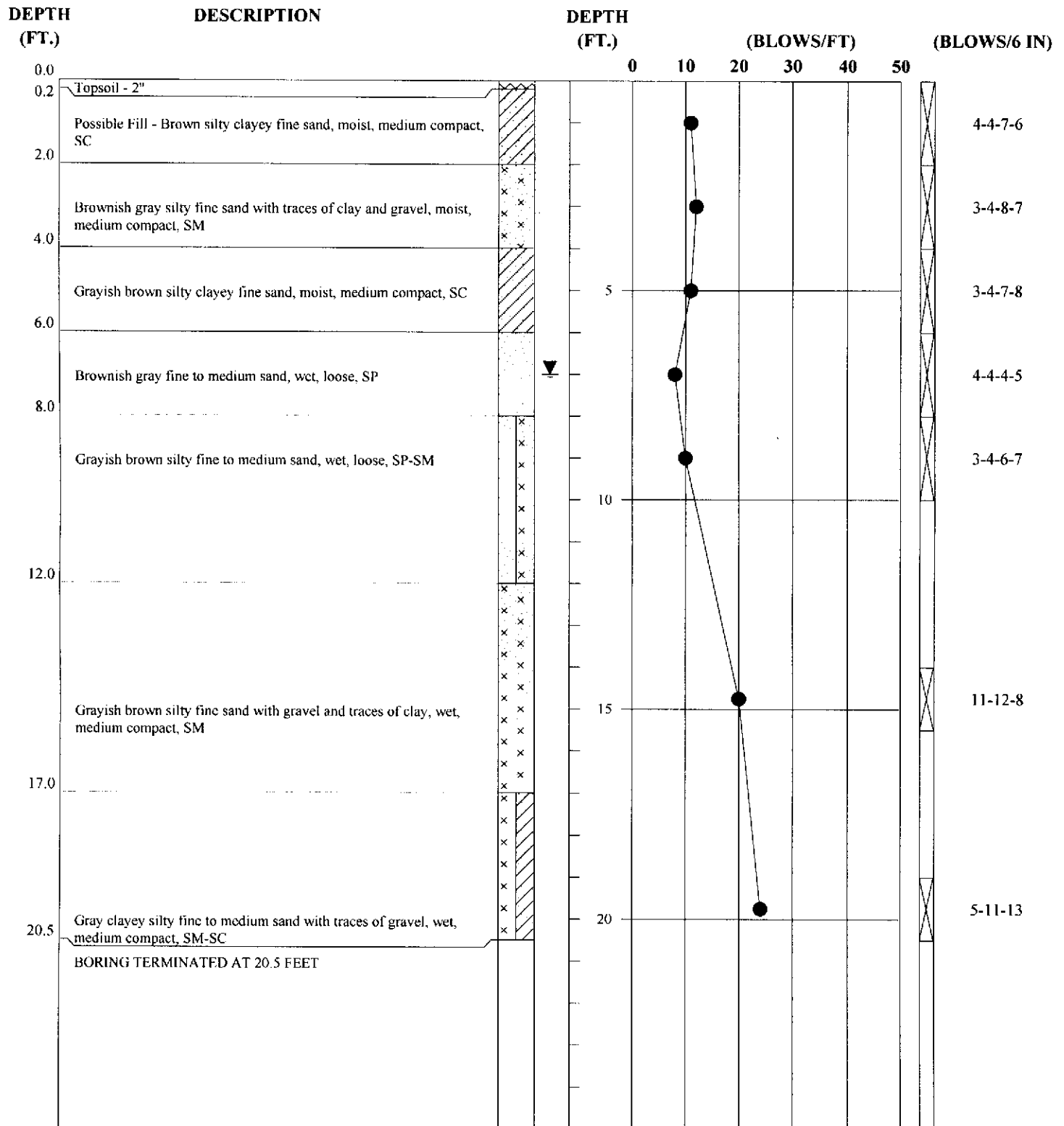
- Gradual Stratum Change
- Approximate Stratum Change
- - Penetration Resistance (N - value)
- ▨ - Standard Penetration Test
- - Undisturbed Sample
- ▼ - Groundwater Level at Time of Boring
- ▽ - Stabilized Groundwater Level Reading

TEST BORING RECORD

BORING NUMBER B-2
DATE DRILLED November 8, 2000
PROJECT NUMBER 00-1778
PROJECT Building #2106
LOCATION Quantico, Virginia

McCALLUM TESTING LABORATORIES, INC.

STANDARD PENETRATION RESISTANCE



NOTES:

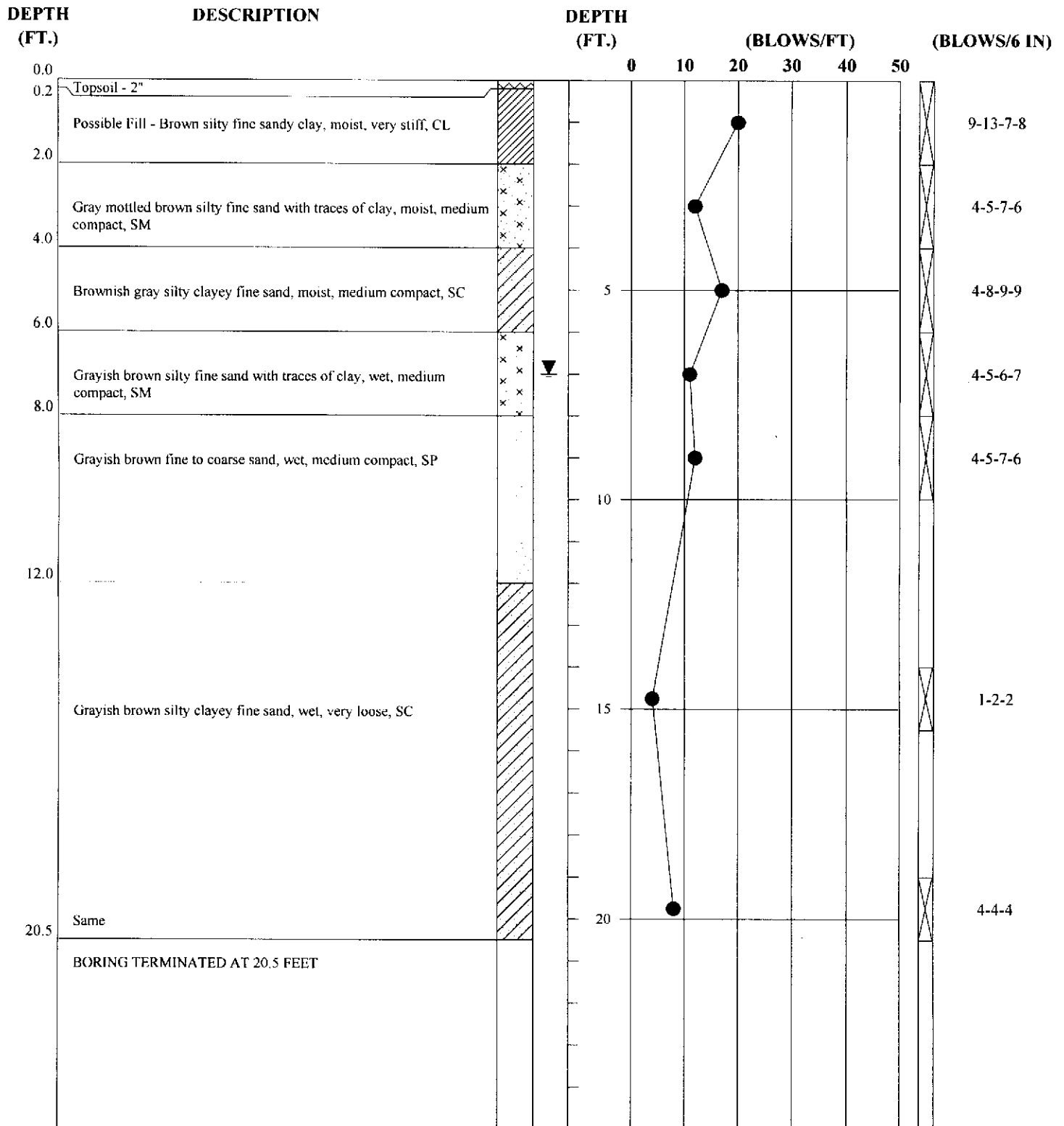
- Gradual Stratum Change
- Approximate Stratum Change
- - Penetration Resistance (N - value)
- ▨ - Standard Penetration Test
- - Undisturbed Sample
- ▽ - Groundwater Level at Time of Boring
- ▽ - Stabilized Groundwater Level Reading

TEST BORING RECORD

BORING NUMBER B-3
DATE DRILLED November 8, 2000
PROJECT NUMBER 00-1778
PROJECT New Armory Building
LOCATION Quantico, Virginia

McCALLUM TESTING LABORATORIES, INC.

STANDARD PENETRATION RESISTANCE



NOTES:

- Gradual Stratum Change
- Approximate Stratum Change
- - Penetration Resistance (N - value)
- ▨ - Standard Penetration Test
- - Undisturbed Sample
- ▽ - Groundwater Level at Time of Boring
- ▽ - Stabilized Groundwater Level Reading

TEST BORING RECORD

BORING NUMBER B-4
DATE DRILLED November 8, 2000
PROJECT NUMBER 00-1778
PROJECT New Armory Building
LOCATION Quantico, Virginia

McCALLUM TESTING LABORATORIES, INC.